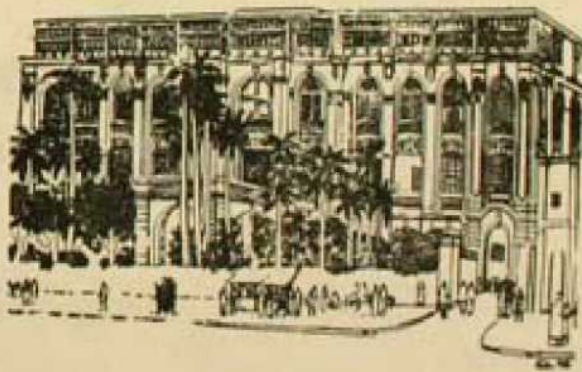


75 Years
of
University Colleges of
Science, Technology & Agriculture
(1914—1989)



COMMEMORATION VOLUME

1990

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Foundation of the University College of Science : National and International Perspectives

J. M. Mandal*

Introduction

THE majestic building of the University College of Science, unique for its architecture and dignified appearance, today looks like the eternal witness of the great personalities who glorified this Science College by their illustrious teaching in the classroom, by their affectionate interaction with the students and by their outstanding researches in the laboratory. Their voices are no more heard, their foot-prints are no more seen—the waves of time washed away their footprints, their voices have merged in eternal silence. But do not their voices echo in the memory and hearts of their students, who have tried to transmit their heritage to the succeeding generations? Are not their ideas of research and thoughts of life-mission still vibrating all over the world and inspiring researchers of the day?

Seventy five years have changed the national and international scene to a considerable extent.

In 1914, the address of this Science College was University College of Science, 92, Upper Circular Road. Now the address is 92, Acharya Prafulla Chandra Road. The road now bears the name of one of the greatest scientist-teachers of this Science College. This Science College is the pioneer in Science-

research and education in the whole of India. In many ways, although the building of the Science College, donated by Sir Taraknath Palit has remained the same, the environment inside and outside the Science College has changed considerably. More and more students have now been flowing in and out. New departments with new disciplines have been opened. They are growing. Outside the Science College premises Calcutta has become more and more densely populated, the air has been polluted by gas and smoke, the sky looks grey instead of blue, gas lights of the streets have been replaced by electric lights and now we have mercury as well as sodium vapour lights.

A retrospect of the national and international events at the time of the foundation of the Science College may help us to grasp the direction of the history of our time.

The University College of Science under the University of Calcutta was established in the year 1914. Historically the time was very significant. The First World War broke out at that time. After industrial revolution in Great Britain, the imperialist countries came out to capture markets, to procure raw materials, to establish colonial rule. Germany wanted a greater share of the world-market from Britain and France. The war began. The horror of the World Wars overwhelmed Rabindranath Tagore, who wrote on the evils of war and about crisis of civilization. Greed and hosti-

* Convener, Publication Committee, Platinum Jubilee Celebration of UCSTA.

lity, hypocrisy of some men at the helm of power and destiny of mankind pained Rabin-dranath Tagore. He was frightened about the fate of human civilization, but did not lose faith in human beings. Imperialism, colonialism had been spreading their tentacles and squeezing the resources of our country. Superstition, illiteracy, poverty became increasingly acute. Just at this time another historical event took place — the October Revolution of 1917 in Russia. Colonial and imperialist forces became shaky. Voices were being raised against economic exploitation, against colonial rule. The battle field against colonialism was prepared. Self-reliance, independence, the era of scientific and rational thinking came in the forefront. In the darkness and horror of the First World War, ray of light could also be seen. The war of independence was started in most of the countries ruled by imperialism.

It is here in Bengal that movements both for being free from colonial rule and also from superstition, illiteracy, had been started earlier. The first sign of movement for science is to awaken the spirit of questioning, to reason. The journey from blind superstition to rationality, from dependence to independence and self-reliance had been started here. Raja Rammohan Ray and Iswar Chandra Vidyasagar are the two pioneers who ushered in the movement of rationalist temper, which is the main preparation for science education. Before going right into the cultivation of different disciplines and compartmentalised science-subjects, they felt that what essentially needed was cultivation of scientific temper, awareness about the utility of knowing and accepting things by logic and reasoning and not by blind faith and dogmatism. Vidyasagar and Rammohan tried to mingle the movement of rationalist and scientific temper with the Renaissance of the

West. In the nineteenth century, a new movement came into existence. The waves of that movement flooded the whole of Bengal and India. From this cultural environment, a new India was emerging.

We now look back and see how Bengal was enriched, how India was enriched and enlivened by the contributions, in different spheres, by almost contemporary presence of Rabindranath Tagore, Acharya Prafulla Chandra Ray, Acharya Jagadish Chandra Bose, Swami Vivekananda and Sir Asutosh Mookerjee.

The socio-cultural environment of Bengal at that time had become so rich and their contributions were so lasting that the establishment of the science college at the initiative of Sir Asutosh was a natural outcome.

At the macro level when the socio-cultural developments in Bengal attained considerable maturity, a number of events of Calcutta at the micro level paved the path of science teaching and research.

Sir William Jones established in Calcutta the world's first society for the study of Asia in general and India in specific in 1784. The Asiatic Society concerned itself with science. In 1814 a Museum was established by Nathaniel Wallich to display objects of science along with the relics illustrating ancient times and manners.

Raja Rammohan Roy in 1816 raised a private fund to establish a Vidyalay in Calcutta to promote Western learning.

In 1835, Medical College of Bengal was established and this served as the centre for scientific studies through experiments.

In 1836, Calcutta College of Civil Engineering was established in the Writers' Buildings, and in 1884, it was shifted to Shibpur Engineering College.

In 1857, University of Calcutta was established. But there was no provision of science-education.

In 1855, Presidency College was established; provisions for teaching natural philosophy, natural history, Geology and Civil Engineering were being made.

In 1861 St. Xavier's College was established. It became the best centre for imparting scientific knowledge. But these colleges had, however, no provision for science research.

We must note that the first centre of modern scientific research was founded by Dr. Mahendralal Sarkar. In 1876, the Indian Association for the Cultivation of Science was established.

The second centre of modern scientific research and teaching at the Post Graduate level was Calcutta University. The Colleges of Science and Technology was founded by Sir Asutosh Mookerjee.

Our Heritage: Distinguished Teachers and Researchers.

In 1914, Debendranath Bose became the first Ghose Professor.

In 1917, Sir C. V. Raman became the first Palit Professor of Physics.

In 1916 Acharya Prafulla Chandra Ray became the first Palit Professor of Chemistry.

In 1916 Satyendranath Bose became a teacher.

In 1916 Meghnad Saha came as a teacher.

In 1939 Girindra Sekhar Basu assumed the chair of Professor of Psychology.

We remember with deep gratitude and reverence the valuable contributions of some of our teachers who are no longer with us namely Prafulla Chandra Mitra, Priyada Ranjan Ray, Jnanendranath Mukherjee, Bhupendranath Ghosh and Nilratan Dhar of Chemistry; Phanindranath Ghosh and Purna Chandra Mahanti of Physics; Ganesh Prasad, A. R. Forsyth and N. H. Young of Mathematics; Nikhil Narayan Sen, N. R. Sen, S. Ghosh and S. K. Chakraborty of Applied Mathematics; Shankar Purushottam Agharkar, P. C. Sarbadhikary of Botany; S. P. Chatterjee of Geography; P. C. Mahalanobis of Statistics; S. C. Mahalanobis of Physiology; N. N. Ganguly of Agriculture; N. N. Sengupta, S. C. Mitra, G. Pal, D. N. Ganguly of Psychology; E. Vredenburg of Geology, Samarendranath Maulik, B. K. Das, H. K. Mukherjee of Zoology; H. K. Sen, B. C. Guha, M. N. Goswami, H. N. Dasgupta of Chemical Engineering and Chemical Technology; P. N. Ghosh of Applied Physics; Arun K. Choudhury of Computer Science; J. N. Bhar of Radio Physics & Electronics and Nirmal Bose of Anthropology.

Acharya Prafulla Chandra Ray, Satyendranath Bose, Meghnad Saha, Sisir Kumar Mitra and Girindra Shekar Bose not only established themselves as pioneer scientists in research and teaching but also they tried to apply the findings of research in practical fields of life. Acharya Ray set up Bengal Chemical—an indigenous industry; Satyendranath Bose set up Bangiya Bijnan Parisad for the propagation of knowledge of science in mother tongue, Sisir Kumar Mitra pioneered Radio research in India and became an autho-



rity on ionospheric problems. He established a wireless laboratory. Many students of these distinguished teachers and researchers have adorned different science departments of

Indian Universities and are still now making all out efforts to augment scientific research in right direction for making our country self-reliant.

Contributors of articles for the Commemoration Volume :

Acknowledgement

We in fact, requested for articles reflecting research environment, teaching environment and job opportunities of that time, from those who were once the alumni of the science college, once hold important positions in distinguished research/teaching institutions/organisations or now engaged in research in any reputed research centre and earned reputation in their respective research fields.

Many responded kindly to our invitation, many could not. We are indebted to those who have contributed articles for this volume. They are the linkages of the past, of those days when this Science College became sacred by the footprints of the distinguished professors who earned worldwide reputation by their valuable researches, by the unique loving teacher-pupil relationship, of the Great teacher-researchers and the present. We

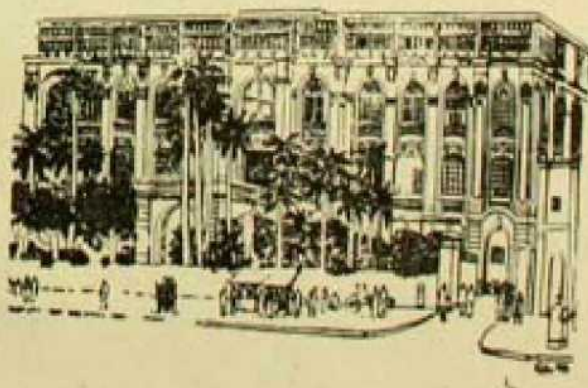
can not but feel proud, when we look back and evaluate the contributions of our predecessors in making India rich in Science and self reliant in many spheres of life by the application of the scientific research they undertook.

We remember with deep appreciation the services rendered by Prof. A. N. Daw, Prof. Dilip K. Bose, Prof. S. P. Mukherjee, Prof. Arabinda Mukherjee, Prof. B. Barman, Prof. N. Saha, Prof. N. Dutta, Dr. Pratima Chatterjee, Dr. N. K. Bhattacharyya, Prof. A. K. Banik, Prof. A. K. Mukherjee of the Dept. of Bengali and Dr. T. K. Mukherjee for the publication of this commemoration volume.

Dr. Anish Deb deserves special mention for his untiring efforts in maintaining liaison between the press and ourselves and many other relevant matters for publication.

SECTION : 1

Reflections of Our Great Teachers



University Science College and Science Education in Our Time

Satyendranath Bose

THIS University is my Alma Mater—and I strive to be one of her faithful sons. Here were spent my student-days as also the early years of my apprenticeship as a teacher. The invitation of our Vice-Chancellor is thus almost a command and I obey him with very great pleasure. But what to say on an occasion like the present? Words of advice would perhaps be deemed out of place—an infliction—and nowhere would they go far into young minds! I have, therefore, decided to narrate before my young friends bits of past history: of this University as it then was—when as fresh graduates, as they are now, we had ventured on a long and arduous trek in search of knowledge. Few had cared to traverse this unknown road before them. They had many hurdles to cross; they had numerous failures to contend with. But there were also a few successes which encouraged them for still further efforts. Luckily the old difficulties have now almost disappeared. But the story may be interesting; it will enable you to compare the old days with the present and I confess outright before my friends that they go out now very much better equipped for their lives' work than we were when we set out quite ill-equipped for our ambitious journey. Those were the days before the famous Sadler Commission. The University had not yet opened the Post-Graduate Departments, and the

old regime continued. More than a hundred years ago Raja Ram Mohan had written to Lord Amherst asking for the introduction of the study of the Western Sciences in India. The University, a few years after, came into existence in due course. But for the first fifty years in the curricula of the University the principal stress was laid on the teaching of English. English was adopted as the medium of instruction of all Arts and Sciences in colleges and in high schools. That was also regarded as the best way of advancing the cause of learning in this country. Our foreign masters had wanted intelligent Indians to help them run their administrations and their offices economically; and so for many guardians living in the cities, it seemed that the broad way to soft jobs, and easy comfortable lives for their wards, ran through the portals of the University. This was clearly not a quick way to disseminate knowledge as the statistics of the progress of literacy in a hundred years would reveal. Many years before, the Catholic Missionaries of Serampore had thought of a better alternative. They were the first to erect a Bengali Printing Press and published mainly religious tracts. But they also helped spreading literacy among the people. They also published text books of Science and Mathematics in Bengali for the beginners. Bengali books on Medical Science were current in

schools and were regularly used by the students before the advent of the University educations. The task of spreading knowledge was soon taken up by the Indian educationists. Iswar Chandra gave us the text books and the keys to the traditional lore of Sanskrit learning, Akshay Chandra revealed the wonders of creation, and there was soon no dearth of Bengali books in all conceivable subjects. In creative literature, after vain efforts to write in a foreign tongue, Madhusudan and Bankim-chandra realised that to gain approval of the people and an easy access to their hearts one has to write in one's own heart's blood—in that native language which springs from the age-old yearnings of the subconscious soul and nourishes the conscious efforts of our people. If things had moved on this rising tide of national effort, if this University had then proclaimed the principle of dispensing learning through the medium of the mother-tongue, perhaps our dreams about the advent of a new era in this ancient land would have come true much earlier. But the old Syndicates and Senators were not convinced. They left teaching in the charge of colleges and schools, and busied themselves with the maintenance of standards by the rounds of inspection and examinations. But the spirit of times moved ceaselessly on, and soon came the rude shock of the National Movement. In 1905, people wanted economic independence. Lost trades had to be revived and new industries had to be started. But the University studies were not oriented to that end. It could not meet the sudden demand for knowledgeable men in Science and Technology. Immediate reorganisation also was not possible. But feelings ran high: the University was condemned as a slave-factory in public meetings. Attempts were made to reorganise education within the province on a broad basis independent of

government control. A National Council dispensing the knowledge of Arts and Sciences through the medium of Vernacular came into existence. Funds were also available from patriotic donors but beyond establishing a College of Technology no lasting results could be achieved. Gradually the political struggle moved on to other arenas and the task of education independent of government control remained unachieved for many years. The old system of educations stood condemned. But there was no satisfactory alternatives to replace it immediately. However, the situation was saved and the popular demands were met to a large extent by the genius of Sir Asutosh who was then at the helm of affairs of the University. He understood the urgency of introducing more satisfactory methods of teaching in schools and colleges. Syllabus and the courses of studies were revised, and the teaching of the experimental sciences was given a prominent place within the University. Before 1908, only a few colleges taught sciences. As a result of the reforms, many colleges, both in the city and in the mofussil, undertook to open laboratories and provide the necessary funds for scientific training for which there were such urgent demands. While the schools and colleges tried their best to meet the demands of the undergraduates of the new age, the University had to come forward herself to shoulder the burden of higher education in Arts, Sciences, and Law. From a merely examining body, the University was thus gradually transformed into a vigorous centre of teaching and research. Sir Asutosh was the principal organiser and the leading spirit of the new movement. All went on very well for a time. The government approved his programme, and the people had confidence in his wisdom and foresight. The legal studies were reorganised in the University Law

College. Funds were forthcoming for the installation of several University Professorships (e.g., in Mathematics, Economics, History and Philosophy). These few years of constructive efforts restored peoples' confidence in the University. Large endowments came from two Bengali Lawyers, Sir Taraknath Palit, and Sir Rashbehari Ghose—land, building and funds. Sir Asutosh now took a great step forward and laid the foundations of the University Colleges of Science and Technology. There is however a peculiar condition attached to the Palit and the Ghose endowments. The Professors have to be Indian scientists. Such suitable persons could not be found immediately for all the new University Chairs at the Science College. C. V. Raman, elected for the Palit Chair in Physics, was then working in the Finance Department of the Government of India and wished to have some time allowed him to make a clear decision. He was anxious to pursue his own researches in his leisure hours at the Indian Association free from all worries of a teaching post. Sir P. C. Ray agreed to be the Palit Professor in Charge of the Chemical Laboratories only after his retirement in 1915. Professors D. M. Bose and Agharkar selected for the Ghose Chairs of Physics and Botany respectively wanted to be sent to Germany for their own researches. The University would have thus to wait for some time before the scheme for the higher teaching of Science could mature. In the meantime the First World War broke out in 1914, and both Professors Bose and Agharkar were interned as aliens. In the meantime dispute arose between the University and the government regarding the control of schools. Sir Asutosh took a fearless stand against the government in matters affecting the academic freedom of the University. In 1915 he was no longer the Vice-Chancellor but still remained

Chairman of the Boards of Trustees of the Palit and the Ghose endowments.

The National Movement had thrown up many idealists imbued with a spirit of adventure. There were a few young graduates who had resolved to devote themselves entirely to Science and soon after 1915 M.Sc. examinees had approached Sir Asutosh for advice and guidance. The name of one of them had been sent for the post of a Lecturer in a government college in a different province, but was not considered on the ground that his qualifications were too good for the post. He wondered how he could possibly get along with his programme of higher studies. One of them had even the temerity to suggest that the University might now undertake herself the teaching of the various courses in Science which were prescribed but were not taught in the government colleges. It was difficult for the youngsters to guess what the great Sir Asutosh thought about their proposals. However, some got special scholarships sanctioned and direction to study certain special branches of science which had come into prominence. He asked another particularly to prepare a report on the possibility of procuring the necessary equipments locally in view of the World War—he was also to report about the probable expenses necessary in the first year for fittings and other equipments in case the University decided to open classes in Physics. Soon it was evident that the University would be teaching science subjects. Sir Asutosh had won over his colleagues who had doubted the wisdom of this hasty act. They would have preferred to wait till C. V. Raman joined, or till the interned Professors returned from abroad. But ultimately they were persuaded to support Sir Asutosh. Thus the Post-Graduate Departments in Chemistry, Physics and Mathematics

were opened even before the Sadler Commission had submitted their report. The members of the Commission came and went on rounds of inspection when regular class work was going on in all the departments, and apparently approved what was going on. It was a risky venture. But the young graduates of the University worked hard to make the programme a success. In Physics the details of the programme were worked out by the Lecturers. C. V. Raman joined a few months later. He found the routine-work going on satisfactorily. He consented to deliver a few lectures but kept himself busy most of the time at the Indian Association where the Palit grant was spent for research purposes. Here some Lecturers worked under his guidance and earned their well-merited Doctorate degrees.

I have only told a part of the story, relying mainly on my personal knowledge. But in all subjects in Arts and in Science, at Ballygunge or at the Darbhanga Building, the beginning of higher teaching took practically the same course. After the Post-Graduate Departments had come into existence the young Lecturers carried the principal load of the new task everywhere. The leader had seen the propitious moment arrive. He had confidence in the young scholars, in their capacity to shoulder the heavy responsibility of hewing new pathways to progress. His call had gone forth and the young people responded. By their devotion, and their enthusiasm, they made the scheme a complete success.

The government had not looked on this new venture with much favour. No grants were forthcoming for the maintenance of the Science Departments and the University had to rely on her own fee fund and on the endowments received from the generous donors for this purpose. But the transforma-

tion into a teaching University met the urgent needs of a nation growing everyday conscious of its own powers. Students came in increasing numbers, they went out, trained and were either absorbed in the growing industries or they started themselves new and successful ventures. Original contributions began to appear. Within five years, young Indians had made their mark in the scientific world. Ghose's papers on the Conductivity of Electrolytes were published in 1919. Saha had his famous theory on the Temperature Ionisation of Stars ready by 1922. Numerous contributions on different subjects followed in continuous stream. Sir Asutosh's hopes were realised, and the name of the Calcutta University soon occupied a respected position in the scientific world. This position has been maintained, the good work has been continued by the successive bands of devoted scholars for about half a century. This has not always been an easy task. Public opinion had undergone violent fluctuation about the need and the importance of University education. During the years of struggle for national independence education enjoyed a very low priority value. Whenever needed, and the call came, students ran out of schools and colleges. Teachers were no longer regarded as reliable guides and they preferred to follow the leaders of the national agitation who assured them that once independence was secured all difficulties would disappear and all problems would find quick and easy solutions. A new era of freedom has finally dawned. For Bengal however the chalice of bliss is tinged with many sorrows and bitter memories. The old land, united by the traditions of centuries of a common culture, now stands divided. This has occasioned movement of people on a tremendous scale. The problem of the rehabilitation of refugees taxes heavily the resour-

ces of our administrators. There has been simultaneously a great demand for technical and scientific training. Schools and secondary education are no longer under the care of the University. Large-scale reforms of secondary education are under contemplation. But, for efficient working of the new plan trained teachers would be necessary and the University has ultimately to supply a large number of well-trained teachers to the schools. Besides, a large number of graduates demand higher training at the University. Their training and test also raise problems of great complexity. Many are refused admission for want of accommodation. And almost every year we hear of unseemly disturbances in the examination halls: an unsympathetic examiner has set a particularly stiff paper, or the questions asked are outside the prescribed syllabus. All these problems require a careful review of all University activities. A closer understanding among the teachers and the taught is eminently desirable. And now more than ever has arisen the need of adopting the language of the province as the medium of instruction in all classes within the University. This had appeared perfectly feasible to the leaders of thought in the province more than fifty years ago. It should again be considered carefully by our Senators and our legislators now. There are now a little over thirty universities in India and many more are bound to follow. As higher education is a Central concern, there is a school of thought which urges an approximately uniform standard for all the universities. They demand the working out of a master plan; they desire that all universities should adhere to it as closely as possible. The need of the same medium of instruction follows, according to them, as a necessary co-

rollary. These planners thus urge the continuance indefinitely of English as the medium of instruction in universities as at present.

I have always spoken against unwise adherence to past policies. This foreign language has been a real hindrance to rapid spread of literacy in the country. In an educational institution, it encourages cram and effectively damps all creative efforts. The first fifteen years of independence have not brought about any spectacular increase in literacy. If there be no rapid spread of modern ideas among our people, our attempts at industrial and technical progress would have to lean heavily on foreign support, and we would be always counted among the underdeveloped nations of the world.

Let us take heart and resolve to follow the lessons of history. Let not our past misfortunes gnaw away the roots of our future progress.

The story now comes to an end. If I have talked mostly about the past it is chiefly to remind ourselves that much more have yet to be done. A quick and wise decision will go a long way towards achieving our purpose, and to make the best use of our present opportunities.

My young friends, as you go out in the wide world, remember your obligations to your motherland. Put your training to best possible use. Do your duty. Your Alma Mater will feel proud of having sent her spiritual sons, who will maintain the traditions of service and adventure.

May God bless you all !*

* Lecture delivered at the annual convocation of the Calcutta University in 1962.

Hundred Years of University Education in India

Priyada Ranjan Ray

THE centenary celebrations of the three oldest universities of India, namely, the universities of Calcutta, Bombay and Madras, in the beginning of the present year, represent an event which naturally calls for a closer examination of the contributions that a hundred year of university education has made to the intellectual, moral and cultural uplift, as well as to the social, economic and political progress, of the country. Such a critical adjudgment will undoubtedly be of great help in the future development or shaping of the educational programme and pattern of India. An excellent historical account of the establishment and growth of these three parent universities will be found in their centenary souvenir volumes, to which we refer the readers for detailed information.

The introduction of the university education in India leading to the foundation of these three universities in 1857 was the outcome of the famous Despatch of 1854, known as Wood's Education Despatch after the name of Sir Charles Wood, the then Secretary of State for India and the President of the Board of Control. The Despatch was issued by the Court of Directors of the East India Company. It was a lengthy document which reviewed the progress of education in India, dealing with English and Vernacular schools.

It made recommendation and provision for the institution of three universities and the establishment of Departments of Education in all the local governments and for giving grants-in-aid to all schools. As a result, the three universities of Calcutta, Bombay and Madras were incorporated by Acts No. II, XXII and XXVII of 1857 respectively of the Legislative Council of India. For over 50 years prior to this the ground was, however, being prepared for the higher education in Western science and thought through the devoted efforts of many Christian missionaries and pioneers of Indian renaissance, including many judicial and executive officers of the East India Company itself. This led to the establishment of schools and colleges for imparting instructions in Western science and languages. The names of William Carey, Rev. Alexander Duff, John Clarke Marshman, Ram Mohun Roy, David Hare, C. H. Cameron, Sir William Jones, H. H. Wilson and H. T. Colebrooke, whose activities were more or less confined to Bengal, deserve special mention. In Bombay, Rev. John Wilson, Jugonnath Sunkersett, Rev. Richard Cobe, Mountstuart Elphinstone, the Governor of Bombay, and Sir Thomas Erskine Perry, Chief Justice of the Supreme Court, did the spade work as the pioneers of Western education. In South India also the Christian missionaries

like Schwarz, Anderson, Braidwood, Miller, Noble and Tucker played a leading part in the introduction of English education from the beginning of the 18th century. Lord Elphinstone, the Governor of Madras (1837-42), also rendered a great service in encouraging higher education by providing for the establishment of a high school which subsequently became the Presidency College of Madras.

In those days there was a long controversy regarding the medium of instruction to be adopted in schools and colleges. Two schools of thought, differing sharply from each other, were more or less equally balanced for some time. One recommended Sanskrit and Arabic along with the encouragement of oriental studies, while the other advised strongly in favour of English education through the medium of English language. A conflict thus prevailed between the Anglicists and the Orientalists, ending ultimately in the triumph of the former, due to the eloquent support it received from distinguished Indian representatives like Ram Mohun Roy and others, as well as from high officials like Sir C. E. Trevelyan and Sir Thomas Erskine Perry, and particularly from Macaulay, the then President of the General Committee of Public Instruction, through his memorable minute of 1835. Macaulay's vigorous rhetoric against the Orientalists, it is said, put a final seal to this controversy. It might be of interest to quote here a few words from his minute :

"It seems to be admitted that the intellectual improvement of those classes of the people who have the means of pursuing higher studies can at present be effected by means of some language not vernacular amongst them. What then shall that language be? One half of the Committee maintain that it should be English. The other half strongly recommend Arabic and Sanskrit. Which language is the best worth

knowing?.....A single shelf of good European library is worth the whole native literature of India and Arabia.....English is the language spoken by the ruling class. It is spoken by the higher class of natives at the seat of Government. It is likely to be the language of commerce throughout the seas of East.....It is manifestly absurd to educate the rising generation with a view to a state of things which we mean to alter before they reach manhood.....There are in this very town (Calcutta) natives who are quite competent to discuss political or scientific questions with fluency or precision in the English language. Indeed it is unusual to find even in the literary circles of the continent any foreigner who can express himself in English with so much facility and correctness as we find in many Hindus.....It is possible to make natives of this country thoroughly good English scholars.....Less than half the time which enables an English youth to read Herodotus and Sophocles ought to enable a Hindu to read Hume and Milton.....We must at present do our best to form a class who may be interpreters between us and the millionsI would strike at the root of the bad system. I would at once stop the printing of Arabic and Sanskrit books. I would abolish the Madrasa and Sanskrit College at Calcutta. No stipend should be given to any student who may repair to the Sanskrit College at Benares and the Muhammedan College at Delhi. The funds which will thus be placed at our disposal would enable us to give larger encouragement to the Hindu College at Calcutta and to establish schools in the principal cities throughout the Presidencies of Fort William and Agra."

Lord Macaulay, while thus paying a high tribute to the intellect of Hindu youngmen and to their aptitude in readily acquiring a correct knowledge of English, writes very disparagingly in no uncertain terms about the value of the oriental learning and literature. His observations were apparently not free from bias and he had no justification, in the words of the Orientalists, 'to proclaim a crusade against every oriental feeling and institution—an open attack upon every stronghold and redoubt, and without any pretension to oriental erudition to declare a belief

that the cherished literature of some hundred millions of people is an unmixed mass of falsehood and absurdity'. Such were the strong and quite reasonable comments on Macaulay's observations by Orientalists like Macnaghten and James Prinsep.

The Government, however, generally approved Macaulay's views and declared in a resolution of 1835 'that the great object of the British Government ought to be the promotion of European literature and science amongst the natives of India and that all the funds appropriated for the purposes of education would be best employed on English education alone'. But the Government did not proceed to the length of abolishing schools and colleges of native learning, and the cultivation of Sanskrit and Arabic continued to exist under Government auspices. Thus it becomes clear why Lord Macaulay is generally regarded as the father of English education in India.

It will, however, be pertinent in this connection to refer to the views of William Adam, who was appointed to survey the state of vernacular education in Bengal. He submitted three reports, two in 1835 and the last in 1838, after travelling extensively from village to village to collect his data. He came to the conclusion that the English language could not be exclusively adopted as the medium of instruction for all people, though he was fully alive to the importance of European knowledge for the purpose of instruction. His ideas are best summarised in his own words :

"Let one abandon for a while his English predilections and open his mind to the impression which fact and observation may produce. Let him traverse a *pargana*, a *thana*, a district from north to south, from east to west in all directions. Let him note how village

appears after village, before and behind to the right hand and to the left in endless succession. It is difficult to believe that it should have been proposed to communicate to this mass of human beings through the medium of a foreign tongue all the knowledge that is necessary for their higher civilization, their intellectual improvement, their moral guidance, and their physical comfort."

It was a very sound, wise and classic report. But, unfortunately in the enthusiasm of ultra-anglicism little heed was paid to it and the vernaculars were not allowed to occupy their rightful place in the educational system of the country, even as channels of distribution and diffusion of knowledge with English standing at a higher level as the channel of acquisition.

The ground being thus prepared for the Western education through the medium of English, the foundation of the universities followed as a logical consequence. But even in the Education Despatch of 1854, which embodied the scheme for the establishment of universities in India for English education, the Court of Directors did not wish to abolish the study of Indian languages. In this they disagreed with Macaulay. The Directors said :

"It is neither our aim nor desire to substitute the English language for the vernacular dialects of the country. We have always been most sensible of the importance of the uses of the languages which alone are understood by the great mass of population. These languages and not English have been put by us in the place of Persian in the administration of justice and in the intercourse between the officers of Government and the people. It is indispensable, therefore, that in any general system of education the study of them should be assiduously attended to."

The Directors also adopted a very wise policy by declaring that education in all schools and colleges should be exclusively secular ; and the persons of all varieties of religious persuasion should be permitted to

participate in the management of educational institutions. Also, no subject connected with any religious belief should be included in the curricula for university examinations. As a matter of fact, the Directors did not like to impose any educational system on the people, which was not wanted or supported by their enlightened representatives. Their intention was quite sincere, and the blame, usually attributed by many political leaders to the Britishers, that they introduced university education through the medium of English language in order merely to train a body of clerks for their administrative work, cannot be justified.

The three universities of Calcutta, Bombay and Madras, as already stated, were established in 1857 and followed the university of London in their pattern with a similar constitution having power to conduct examinations and award Degrees. The model adopted was, therefore, of a purely affiliating type. The object aimed at was the promotion of useful knowledge in the form of Western science and literature among the Indians through the medium of English. Provisions were made for conferring Degrees on the result of examination in Arts, Law, Medicine and Civil Engineering. Science subjects were covered by the Art Degrees like Bachelor and Master of Arts. The three universities, thus constituted, were not, however, universities in the truest sense of the term. A university has got two main functions :

- (1) Communication of knowledge through teaching.
- (2) Advancement of knowledge through research.

Neither of these functions are, however, fulfilled by a university of the affiliating type.

A university, as pointed out by the Calcutta University Commission of 1917, should represent a place of learning 'where a corporation of scholars labour in comradeship for the training of men and the advancement and diffusion of knowledge'. The universities of Calcutta, Bombay and Madras as constituted by the Acts of 1857 were not corporation of scholars, but only of administrators for testing of learning by examinations and for rewarding by Academical Degrees persons who could pass those tests in different branches of Literature, Science and Art. Teaching, one of the primary functions of the university, was more or less carried out in the self-contained or autonomous college over which the university had little control except by laying down the curricula for different examinations; and the college teachers, on the other hand, had no voice in preparing the curricula. This was indeed a very unsatisfactory state of affair with the inevitable consequence that too much emphasis was laid upon the preparation for examination by the teachers and the students alike. It allowed little scope for originality for the teachers and of thought or thirst for real learning for the students. All spirit of enquiry disappears under such a system and the hall mark of the university is coveted merely for its market value.

The relation between the university and the schools was also similar, the final examination of the school being conducted by the university according to the curricula fixed by it, on the result of which certificates were given to the successful candidates. But the Department of Public Instruction of the Government exercised a closer control over the schools.

Soon after the incorporation of the three

universities the number of colleges seeking for affiliation to the universities continued to increase. The English education was heartily welcomed by the leaders of the Hindu community and it became very popular among the Hindus, but the feelings of the Muslims were not quite friendly. As a consequence they lagged behind the Hindus in this respect, which possibly gave rise to many troubles later on between the two communities, relating to their participation in the administration of the country. The number of schools and colleges went on increasing as also the number of students in them with consequent increase in the number of candidates for examinations. Demands for new universities naturally arose and two new universities were established, one at Lahore in 1882 and the other at Allahabad in 1887. These were also of affiliating type to begin with.

The University Act of 1904 embodying the recommendations of the University Commission of 1902 suggested reconstitution of the Governing Bodies of the universities and restriction of conditions for affiliation of colleges to the university, as well as provision for teaching by the appointment of professors and lecturers with a view to the promotion of study and research. The recommendations were not received with favour by the Indian public opinion, according to which these were calculated to retard the progress of higher education in the country due to undue State control over the administration of the university. A Government resolution in 1913, however, clarified the policy in regard to higher education. In this, it was explained that the restriction of the area of jurisdiction of the affiliating universities was found necessary in order to create new teaching and residential universities in each of the Provinces. The

establishment of such universities at Dacca, Aligarh, Banaras, Rangoon, Patna and Nagpur was then in view of the Government. The First World War, which broke out in 1914, delayed the implementation of the resolution, though the two teaching and residential universities at Banaras and Patna came into being in 1916 and 1917 respectively. A teaching and affiliating university was also started in 1916 at Mysore by the State Government. The university of Calcutta too under the dynamic and dominating leadership of Sir Asutosh Mookerjee launched upon a scheme of direct teaching on an extensive scale by the creation of Post Graduate Departments. This was a very significant event in the history of Calcutta University and of the progress of higher education and research in India. For, it brought in its train international reputation for the professors and scholars of the university and provided a lead for the other universities to follow.

The Calcutta University Commission under the Chairmanship of Sir Michael Sadler emphasised upon the teaching function and recommended the separation of the Secondary and Intermediate Education from the university. Suggestions were also made for the university to seriously take up the problems of vocational and professional teaching. Many of the recommendations of this Commission could not have been implemented for the lack of financial support from the Government. But other Provinces and States took lessons from these recommendations and many new teaching universities were started in the years following 1917. These include the Osmania University at Hyderabad (1918) under the State management with Urdu as the medium of instruction for all university classes, the Universities of Aligarh (1920), Lucknow

(1920), Dacca (1921), Delhi (1922), Nagpur (1923), Andhra (1923), Agra (1927), Annamalai (1929), Travancore (1937), Utkal (1943) and Saugor (1946). With the exception of the universities of Agra and Utkal which work merely as affiliating and examining bodies, all others are generally of the teaching type combining affiliating or federative character only in a few cases. Since the attainment of independence, several other universities have come into existence in rapid succession, e.g., Rajputana (1947), East Panjab (1947), Gauhati (1947), Poona (1948), Roorke (1948), Kashmir (1948), Gujrat (1949), Baroda (1949), Damodar Thackersey Women's University (1949), Karnatak (1950), Viswa-Bharati (1951), Sri Venkataswaran (1953), Ujjain (1954), Jadavpur (1956), and Anand (1956 with Hindi as medium of instruction). Most of these recently started universities combine features of both teaching and affiliating bodies with the exception of a few like Rajputana and Kashmir which are of purely affiliating type.

The universities of Bombay and Madras were also reconstituted in 1928 and 1923 respectively when they followed the example of Calcutta University by assuming the function of teaching for Post-Graduate courses.

This gives a short review of the origin and growth of the University education in India during a period of one hundred years since 1857. We shall now proceed to take stock of its achievements and failings according to the standard we set up, and discuss the problems that face it.

The aim, purpose and true function of the university in the life of a nation cannot possibly be better defined than in the words of that great Indian educationist, the late Sir Asutosh

Mookerjee. In his annual Convocation Address as the Vice-Chancellor of the Calcutta University in 1922 he forcefully expressed his conception as follows :

"To my mind the University is a great store house of learning, a great bureau of standards, a great workshop of knowledge a great laboratory for the training as well of men of thought as of men of action. The university is thus the instrument of the State for the conservation of knowledge, for the discovery of knowledge, for the distribution of knowledge, for the application of knowledge, and above all, for the creation of knowledge-makers."

A university, therefore, is best judged by (1) the quality of its teachers and students, (2) by the contribution it makes to the world's stock of knowledge, and (3) by the character and conduct of its alumni as citizens and leaders of the society.

Teachers communicate knowledge to the students : they are thus related to each other as donors and acceptors. One of the primary functions of the university consists, as already stated, in the communication of knowledge. This cannot be effective if the teachers have nothing to communicate other than what is found printed in text-books, and the students do not care for anything other than what is required for his examination purpose. It is a general complaint that the universities in India today are in dearth of competent and inspiring teachers ; and that the standard of teaching as well as the average quality of our university graduates are gradually deteriorating. In the past before the World War II, India could however count upon many eminent teachers and scholars both in Arts and Science, though their numbers were very limited. There might be many contributory causes to the present state of affairs. The evil effects of an insane craze

for University Degrees as the only passport for Government appointments make both the teachers and the taught indifferent to the real and systematic knowledge of a subject. Overcrowding in the colleges, standing in the way of personal contact between the students and the teachers, renders the teaching uninspiring and ineffective. Such overcrowding in the practical classes in science laboratories makes the training almost useless. Unlimited admission to colleges for increasing the fee-income without any effective control by the university makes the atmosphere of the college little better than that of a market place, and cannot but lead to very indifferent products. In the Departments of Post-Graduate Teaching of the universities also, no better results can be expected as they have to deal with the ill-equipped recruits from the colleges. Comparatively low salaries of teachers in the colleges and the universities make them discontented and indifferent to their own duties, and tempt them to seek subsidiary sources of income at the cost of their interest in teaching work. What is worse, they often lose their integrity and strength of character in trying to improve their position and income by sycophancy and snobbery. Teachers fail to inspire their pupils with any nobler ideal. High salaries of the administrative, scientific and technical posts in the Government service lure away the best products of the university from the teaching profession. It is no wonder therefore that there is a crying need for properly equipped scientific workers and technicians, which the universities even after 100 years of their activities fail to supply, and India today has to depend upon the service of foreign experts at great cost for running many of her basic industries. Even Directors of many National Laboratories had to be recruited from abroad.

Our attention will now be directed to an assessment of the contribution made by the Indian universities towards the extension of the bounds of knowledge. Confining ourselves within the limits of scientific and technological subjects, for which there are definite standards of verification, it may be observed that the progress has neither been adequate nor commensurate with the century-long period of university education in India. It is indeed well known that India has produced some very eminent scientists, who by their investigations have acquired international reputation of high order, including even the highest. But their number can be counted at the tips of one's fingers; and it must not be forgotten that the progress of science in a country is best measured by the standard and quality of the publications of its average worker and not by those emanating from a few gifted personalities. Intellects of exceptional brilliance are known to flourish even under the most adverse circumstances. They cannot therefore be regarded as the normal product of the system in vogue. On this basis, the quality and quantity of scientific research in India are found on comparison to lie even far behind those of very small countries like Switzerland, Japan and Holland not to speak of the highly advanced countries as U.S.A., U.K., U.S.S.R., Germany and France. Remembering that the universities of Calcutta, Bombay and Madras were incorporated only about 20 years after the foundation of the London University (1836), it might have been reasonably assumed that our progress at the present time would correspond to the advancement of science and technology in U.K. in 1936. But the fact is that we are possibly much behind U.K. of even 1910, particularly in applied sciences and technology. One might, however, argue that during the British rule the university educa-

tion, specially in science and technology received little support from the State, and the medium of instruction in English, a foreign language, was a great hurdle in the pursuit of science. But the argument about the lack of financial support and State encouragement cannot apply to the post-independence period of ten years extending from 1947 to 1956. It will be quite pertinent to enquire if we have made any real progress in science and technology during this period, apart from raising costly and magnificent edifices for various National Laboratories and other research institutions, and equipping them with the most up-to-date and expensive instruments. The Government has been exceptionally generous in providing funds and facilities for scientific and industrial researches but the result, it cannot be denied, has been disproportionately poor. For, India is not yet in a position to meet the demands of properly equipped scientific workers for her industries, competent teachers for her universities, capable investigators for her research organisations and gifted organisers for her scientific services. The reason for this failing is not far to seek ; indeed it has already been referred to in what we have discussed before. The exclusive encouragement of teaching and research at the Post-Graduate level and above, and utter neglect of training in the colleges and schools, cannot but lead to such an undesirable state. For, bad raw materials are never known to yield good finished products. Such attempts are no better than building a pyramid upon its apex. Too much emphasis is being bestowed upon materials and too little on men. This is possibly worse than the other way.

Lastly, we may enquire how far the university education in India has succeeded in shaping the character and conduct of its

alumni as useful citizens and reliable leaders of the society ; how far it has helped them in developing their mental power, in strengthening their moral fibre, in awakening the emotions of their conscience, in humanising their sentiments, in stimulating their regard for truth, in ennobling their ideals, and in elevating the whole attitude of their life. Judging from these standpoints, it must be admitted that the result has not been very encouraging or heartening. It has not enabled our youngmen to fight successfully against moral evils and material wants. Unemployment, corruption amongst even highly paid officers of the State, nepotism, adulteration of drugs, insincerity and expediency in daily intercourse with friends and colleagues, party politics of a degrading character, vanity and jealousy even among members of the learned professions, are the usual features of our modern social and civic life. According to some this unhappy state of society results from a blind pursuit of scientific materialism and scientific education divorced from humanities. The two global wars have merely accelerated this tendency to materialism. It is, therefore, suggested by many eminent educationists that humanities should be introduced as a compulsory subject for all students of science. Similarly, a course of general science should form a compulsory subject for all students of arts. In India, however, there can be no remedy to these evils until and unless the trainings at the secondary and collegiate stages are radically improved. Character does not form unless the mind is moulded at the formative stage by personal contact with inspiring teachers.

In conclusion we would like to discuss here briefly the main problems that face the university education in India today. Most of these problems are very old dating from the early

days of university education, but they have assumed a rather complicated character in free India under altered circumstances. These are :

- (1) The relation between the university and its colleges.
- (2) The relation between the university and the State.
- (3) The medium of instruction.
- (4) The relation between teachers, students and the university.

(1) We have discussed before incidentally the relation between the university and the colleges in the early days of university education. The condition has though somewhat improved now with increased control by the university and with the colleges having been legally declared as constituent parts of the university, yet it is bad enough. For, most of these are still run on mercantile principles, which seriously affect their efficiency and usefulness. It should be realized that the colleges are integral parts of the university and must not be allowed to function as autonomous bodies in any respect. They should be incorporated in the organized academic life of the university. Rather drastic actions like curtailing severely the numerical strength of each college, appointing teachers of approved qualifications and raising their salaries, providing adequate funds for the improvement and expansion of laboratory and library, screening out ill-equipped candidates for admission, etc., will be necessary for the purpose. Otherwise, it will not be possible to arrest the huge waste of human materials and to prevent the frustration which are now eating into the vitality of our whole educational system.

(2) The universities are created by the acts of legislature, which define their constitution, functions and powers. The relation between the university and the Government assumes therefore a special significance. In the early days the constitution of the university was devoid of any elective element, which placed it practically under complete Government control. The elective element was first introduced by the Act of 1904, though to a rather nominal extent. The history of the Indian universities shows that the relation between the universities and the Government has frequently been marred by conflicts, arising from Government attempt to exercise control over the management of university affairs and to convert the universities into a mere office or department of the State. The vigorous opposition offered by Pherozeshah Mehta and Gopal Krishna Gokhale to some of the recommendations of the University Commission of 1902 and by Sir Asutosh Mookerjee against the University Reforms Bills by the Government of Bengal in 1923, have now attained historic importance.

Though the constitution of the universities has now been considerably changed since the attainment of independence, which has reduced the number of nominated members and has increased the quantum of the academic element, indirect control of the Government over the university is still strong, effective and far-reaching. The universities with their democratic constitution should be allowed complete freedom and autonomy for their expansion and growth, unless dominated by internal intrigues and party politics that vitiate the academic life. The observations of the University Education Commission of 1948-49 are well worth quoting in this connection :

"But we do not believe that more control from outside is the way to achieve reform. On the contrary a great many of the present evils arise from the fact that most of our universities have no real autonomy whatever, and have proved incapable of resisting pressure from outside. Universities *should* be sensitive to enlightened public opinion; they should *never* let themselves to be bullied into action that they know to be educationally unsound or worse still, motivated by nepotism, faction and corruption. The right public policy is to give a university the best possible constitution, securing among other things of the inclusion of wisely chosen external members of its governing body and then to leave it free from interference."

Equally remarkable views were expressed as early as in 1867 by Sir Alexander Grant, the Vice-Chancellor of the Bombay University, regarding the freedom of the university and the right attitude that the Government should adopt in its dealings with that body. Even after such a distance of time and the vicissitudes of circumstances, these observations are as much valid today as in those days:

"A university like ours occupies necessarily a delicate position..... It derives all its current resources from the Imperial Treasury, and its acts are all subject to veto from the local administration. Under such circumstances.....there cannot but be a tendency for a university to lose caste, as it were, and to come to be regarded as a mere office or department of the State.

What is to be apprehended from this tendency is not only loss of dignity to the university itself, but a loss of the highest kind of efficiency in its working.

For the mission of a university in a country like this is nothing else than to create an intellectual and vital soul among the people; and there can be no question whether this mission is likely best to be fulfilled by persons feeling themselves nominated merely to carry out the views of a government, or by the free and enthusiastic action of men feeling responsible to themselves for the good or bad success of the university."

I have quoted the above observations at

length, because there is now growing a strong tendency on the part of our Government, which professes to be a democratic State with socialistic pattern, towards an increasing control of the various academic bodies in the country by insisting on the inclusion of nominated official members in the governing bodies of these institutions, and even in Selection Committees for Professors and Teachers, as condition for financial assistance.

(3) The problem of the medium of instruction in the Indian universities arose with the introduction of English education in India long before the foundation of the three oldest universities. This has been discussed before as the battle of languages between the Anglicists and the Orientalists with the ultimate triumph for the Anglicists through the powerful advocacy of Macaulay. But with the attainment of freedom and the establishment of the National Government the problem has reappeared in a more complicated form with an almost fierce controversy among the educationists. Besides, it is so wrapped up, as the University Education Commission observes, in sentiment that no calm and detached consideration is possible under ordinary circumstances. The matter has been further complicated by the violent agitation against the recommendations of the States Reorganisation Committee, when the people all over the country appeared to have been seized with an epidemic malady of linguistic lunacy.

It cannot be denied that the adoption of English as the medium of instruction for higher and university education for over a century and a quarter has done some real benefit to the country. It has helped in political and, to a certain extent, cultural unification of the country. It has made possible the inter-

course between the enlightened and cultural groups of different provinces. It has made the knowledge of Western science easily accessible to the youths of the country. Last, but not least, the English education had been responsible, so to say, to develop the spirit of patriotic nationalism in India which ultimately led to her freedom. It also helped in liberalizing the Indian mind and in eliminating many evil customs and superstitious practices from the society. But there is another aspect of the problem as well. It is said, and not without reason, that the adoption of English as the medium of instruction has retarded the diffusion of knowledge to the masses and has created an aristocracy of intellect to whom the ignorant masses are almost untouchable. But is it not a debatable point, if the universities with the resources at their disposal would have been in a position to provide higher education for a larger body of students in Sankrit or Persian, or even in any vernacular, than what has been possible through the medium of English? Would not the adoption of Sankrit or Persian create an equally small aristocratic class of learned people more or less detached from the masses? Were not the vernaculars too undeveloped to meet the demands for the purpose of use as medium of instruction? Would not the adoption of any particular vernacular as medium of instruction give rise to a bitter controversy and a spirit of separatism in the country? We would like to draw the attention of our readers to one important fact in this connection. It is the remarkable progress that many vernaculars have made during the period of hundred years under review, in spite of the English remaining as the medium of instruction in the universities. It must be admitted that contact with a living and rich language like English

has enormously helped the development of many of our vernaculars.

Since the attainment of national freedom there has been a demand from several quarters for a national language to replace English. It is quite natural that an alien language holding a dominating position in the field of national culture would hurt the national feeling. But the problem for India with her vast population, with a dozen of different languages and hundreds of dialects, is a very complicated and difficult one. Of these, Hindi claims the largest number of adherents, being their mother tongue. The Indian Union has already adopted Hindi as the National language. But the University Education Commission indicated the inadequacy of Hindi as a medium of instruction in the university for immediate replacement of English, particularly in scientific subjects. None of the other principal regional languages were considered adequate for the purpose by the Commission. Adoption of regional languages for the university education is neither desirable nor wise, as it will give rise to a fissiparous tendency and parochial mentality, and create extreme difficulties in the matter of inter-university migration of teachers and students, in the maintenance of inter-university contacts, in the proceedings of all India scientific and literary conferences, and in general in all sorts of inter-provincial cultural intercourses. The Education Commission, however, has given no definite lead to the country on this difficult problem. The Bombay University Reorganisation Committee in its Report in 1951 has, however, made some quite sensible suggestions. The Report states that the English should be retained as the medium of instruction in the universities for a period of at least 15 years until the time

arrives for its replacement by Hindi, adopted as the official language of the Indian Union. At the same time the Committee is of opinion that English should continue as an equal partner with Hindi. For, English is a language of international status, and is essential for advanced studies and international contacts. We are also of view that the Indian universities should adopt two different languages as medium of instruction, either the Federal language (Hindi) and English, or the regional language. If properly developed, and English, In the latter case Hindi should form a compulsory paper for all, and similarly the regional language in the former. A classical language, namely Sanskrit, in our opinion should be introduced as a compulsory subject along with English and Hindi in the High School or at the Secondary Educational stage, where the regional language should form the medium of instruction. In effect each student will have to acquire a thorough knowledge of three modern languages (Hindi, vernacular and English) and a somewhat general knowledge of Sanskrit. A knowledge of Sanskrit will be very much helpful in developing the vernaculars, as Sanskrit may be viewed as the mother of most of the regional languages of India and, on account of its rich vocabulary and high potentiality, it is in a position to create new meaningful words to express new ideas. Many might think that a study of 3 or 4 languages is bound to press heavily on the mental capacity of the students almost to a breaking point. But experience tells a different story. In Switzerland, where students are generally required to acquire proficiency in 3 different languages, *viz.*, German, French and Italian, all of which are the official languages of the Federal Republic, in addition to one classical or English language (optional),

no difficulty as to the progress or efficiency of instruction has ever been reported.

That the English language has taken a deep root in the cultural field of India, and still holds a dominant position, is best illustrated by an analysis of books published during the year ended 31st March, 1957, and submitted to the National Library under the Delivery of Books Act, from the different States of India :

Total number of books published	37,114
Number of English books	11,399 (31%)
„ „ Hindi books	7,995
„ „ Bengali books	3,271
„ „ books in all other languages	the rest

(4) The University is a corporate body composed mainly of teachers and students engaged in the noble task of communication and advancement of knowledge under the fostering care of its administrative officers. It cannot purposefully function unless there is maintained a cordial relation and co-operation between all the three units. They are partners in nation building activities, which include the training for citizenship, as well as for leadership in all important walks of life, and in the great endeavour for the diffusion of culture and the advancement of learning. There can be and must be no conflict or clash of interests between them. Strikes and hostile demonstrations by the students or teachers are merely indicative of a diseased condition of the body. Such conflicts or disturbances, from whatever reason they may arise, retard the progress of education and defeat the very purpose, which the university strives for. Unfortunately in free India today, the universities are not free from such internal conflicts. At some places these have been so frequent and violent that

the regular functions of the university have to be suspended for a period. All persons of goodwill and right thinking should see that such conflicts can never arise in the universities and hamper their normal working. Those who encourage such conflicts by exciting the passions and prejudices of the young mind for any extraneous reasons deserve condemnation in no uncertain terms. The interest and objective of the teachers, students and administrative officers of a university cannot differ except what are fanciful, ignoble and make-up. Overcrowding in colleges, lack of proper academic atmosphere and cultural activities, inadequate facilities for sports and social contacts between the students, teachers and the university officers, are naturally the predisposing causes of many such conflicts. Steps should be taken by the State and the university authorities to remedy these defects.

After all, it should not be forgotten that the achievements of a university do not consist in the stately buildings in which it is housed, the number of books and periodicals in its library, the valuable instruments in its laboratories, and the number of students in its roll or of teachers in its service. The measure of its real greatness lies in the contribution it

makes to the world's stock of knowledge, in the intellectual and moral excellence of its teachers and scholars, in the welfare of the society which its alumni and members create, and in the nobility of the ideal it strives for. A university can certainly claim a title to greatness if it has been able to reveal any dark domain of Nature or of human mind by its efforts, and if it can help diffusing a spirit of service and a nobler ideal of life throughout a whole population by the example of its alumni. From what has been discussed here, it is possibly clear that the hundred years of English education in Western science and thought has led India on the path of progress out of the chaotic confusion of medieval darkness, though the pace of her advancement has not been as rapid as one might have expected. It should also be admitted that this Western education has rudely shaken many of our cherished traditions, beliefs and habits of life, not always to the benefit of our mind and soul. May India, with the attainment of her freedom, recover her old self in a new synthesis of Western science with Oriental wisdom. May the Indian universities contribute to this end and fulfil their destiny.*

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Scientific Education and Research in the Calcutta University During the Last Hundred Years

Debendra Mohan Bose

WHEN discussing the role of the Calcutta University in the promotion of the teaching of science and of scientific research in this country, it is worth recalling that efforts to teach science along with English literature and western philosophy to the people of this country, began in the first decade of the nineteenth century. The pioneers of this movement, who were called 'anglicist', were able to found the Hindu College, in which were taught, besides Languages, History, Geography, also Astronomy, Mathematics, Chemistry and other sciences. This College was the fore-runner of what became known as the Presidency College founded on June 15, 1855; the latter had till the foundation of the University College of Science and Technology in 1916, taken the lead in the teaching of science and in academic scientific research.

During the first half of the nineteenth century, other institutions for higher teaching like the Serampore College, the General Assembly Institution, the Calcutta Madrassa, the Fort William College, the Sanskrit College, the Hughli Mohshin College, the Krishnagar College, the Bethune College, the Krishnath College were founded.

The same period witnessed the development of medical and engineering education

in Calcutta; institutions for imparting instructions and practical knowledge in these professional subjects were started.

The Medical College, founded in 1835, provided combined instructions in preliminary sciences along with clinical training in all the medical subjects, such as medicine, surgery, midwifery, *etc.*

The first move towards introducing engineering education on western lines in Bengal, was taken when a chair of engineering was sanctioned for the Hindu College. But no regular instruction for engineering could be given before 1856, when an institution was started in the Writers' Building, Calcutta.

The next step in the development of higher education was taken in 1855, when the Managing Council of the Hindu College decided to hand over their assets to the Government of Bengal, and agreed to the refounding of the College on a non-sectarian basis, as the Presidency College.

The institutions mentioned above were founded for imparting instructions in oriental and occidental languages, philosophy, law, mathematics and science. In addition, training was given in engineering and medicine. Their aims were to widen the intellectual

horizon of the alumni, as well as to train them for professional careers. At this pre-university stage, the other functions of a university, conservation as well as advancement of knowledge, were served mainly through the activities of the Asiatic Society founded in 1784 by Sir William Jones, whose aim was to undertake enquiries, within the geographical limits of Asia, on whatever is performed by man or produced by Nature. The initiative taken by the Society in the rediscovery of the almost forgotten heritages of ancient India were published in the Society's journal, *Asiatic Researches*. Jones and Wilkins were truly the fathers of Indology. They were followed by Colebrooke and H. H. Wilson. Later came scientific investigations of India's fauna, flora, geology, meteorology, by members of the Society. These scientific and archaeological activities of the Society were taken over by the different Surveys established by the Government of India, on the initiative of the Society. The valuable collections of the Society formed the nucleus of the Indian Museum. It was also during this period that many libraries, attached to the Asiatic Society and to the Surveys, were started. Taken together they formed probably the most valuable collection of books and journals and manuscripts found in any city in India.

It was in this milieu, that proposals were made for the foundation of universities in the three presidency towns of Calcutta, Madras, and Bombay. By an Act of Incorporation passed by the Government of India on January 24, 1857, these three universities were founded. At the inception, the universities adopted the form, government, and regulations of the London University. The functions of the Calcutta University were, as defined in the preamble of the Act, to ascertain by means of examinations, the persons who have acquired

proficiency in different branches of Literature, Science and Arts, and to reward them by academical degrees, as evidence of their respective attainments, and as marks of honour. The practice prevalent in English universities of having honours degree courses was also followed. There were four faculties of Arts (including Science), Law, Medicine and Engineering. Instructions in Engineering and Medicine were confined to the two Colleges mentioned earlier. The existing institutions for higher studies and others, started since the foundation of the Calcutta University, were given affiliations after favourable inspection reports.

Science as an additional subject for examination was introduced in the B.A. syllabus of 1862-63. The subjects offered were, Mathematics, Physics and Chemistry, Zoology and Geology. In 1872 the B.A. syllabus was divided into two distinct courses *viz.*, Arts (A) and Science (B).

The University Act of 1904 added some additional responsibilities to the University, which included the assumption of teaching function, maintenance of lecture rooms, libraries, museums, laboratories and workshops for the promotion of teaching and research, also for the institution of University Professorship *etc.*, the introduction of modified system of examination, the awarding of the doctorate degree based on submission of thesis.

There were also some important changes in the examinations and curricula which are worth noticing—the F.A., B.A. and M.A. examinations were bifurcated in two *viz.* the arts courses—I.A., B.A., and M.A. and the science courses—I.Sc., B.Sc. and M.Sc. While the arts students could take up one science subject along with the compulsory subjects like English and later also Bengali, the Science

students, from the B.Sc. stage were not required to take any language subjects, like English or Bengali; this has brought along with it certain disadvantages. For it is desirable that every science student should have some training in ability to express themselves with clarity and precision.

Science teaching and research during the period 1875—1909: During this period, the University had not taken up any responsibility for science teaching and research, which were entrusted to the affiliated colleges. Of these the most important one was the Presidency College which was at that time considered not only to be the best in the Presidency of Bengal, but also according to some in the whole of India. This College specialised in honours as well as in post-graduate teaching. It had, till the Calcutta University undertook to provide for teaching and research at the post-graduate stage, served the function of a University College. Many of the large provincial universities in England, like those in Manchester, Leeds, Birmingham, Newcastle *etc.* started as University Colleges; these later obtained recognition as universities. Calcutta, with its increasing university student population, is becoming too large to be managed by a single university. Last year the institutions under the National Council of Education, have been consolidated into the teaching University of Jadavpur. We hope that at a not very distant future, the Presidency College will be converted into a similar teaching university.

To return to our account of development of science teaching in Presidency College, we find that with the erection of the large and commodious building on the newly acquired site of the College in 1875, to which was later added the Baker Laboratory, provision could be made for accommodation of

laboratories where the students could supplement their lecture instructions with laboratory exercises. This was a momentous step, whose importance was not recognized then. Chemistry was the first subject to benefit from this increase in accommodation. In 1875 Alexander Pedler, who later became a F. R. S. was appointed Professor of Chemistry; he was entrusted with the fitting up of a chemical laboratory. J. C. Bose, who was appointed Professor of Physics in 1885, was probably the first to introduce laboratory instruction in Physics. Study of Geology was introduced when T. H. Holland of the Geological Survey was appointed the first Professor of Geology. The Biological Department was started in 1900 by S. C. Mahalanobis. The Botany Department was separated out in 1913 as an independent unit, with the appointment of J. C. Nag as Professor.

Researches: The Centenary Volume of the Presidency College (1955) contains an impressive list of research publications by members of the College. The earliest of these publications is by Alexander Pedler, on Cobra Poison in 1880. Pedler later became a Fellow of the Royal Society of London. Two other members of the Presidency College obtained this distinction. J. C. Bose, who earned the applause of western scientists by his compact electric wave apparatus, later turned to investigations in Plant Physiology, where his contributions were more extensive and even more remarkable. The third F.R.S. is P. C. Mahalanobis, who succeeded J. C. Bose to the chair of Physics, and like him he left Physics for an adjoining field of research in Statistics. The Institute of Statistics founded by P.C. Mahalanobis has attained international recognition as a leading centre for researches in pure and applied statistics.

Prafulla Chandra Ray made exhaustive contributions to our knowledge of the nitrite compounds of different metals and to the history of Hindu Chemistry. He is recognized as the founder of a vigorous school of research in Inorganic Chemistry in Bengal, which was subsequently taken up in other parts of India. He is also justly respected for the encouragement he gave to a brilliant group of the younger generation of scientists whom he inspired to dedicate their lives to the advancement of science.

The contributions made by the staff of the Presidency College have covered many branches of science, including Mathematics, Physics, Chemistry, Geology, Botany, Physiology and Zoology.

Amongst the non-government colleges, the missionary institutions have also taken prominent part in science teaching. Their activities may be traced back to 1830, when the General Assembly Institution was founded by Dr. Alexander Duff; later Dr. Duff separated from this institution and established another institution called the Free Church of Scotland Institution. Later both the Institutions were combined under the present name—the Scottish Church College. This institution, which has been famed for the number of theologians and philosophers it had on its staff, has also acquired a good reputation for its science teaching.

The St. Xavier's College founded by the Society of Jesuits in 1860 had always distinguished scientists on its staff, amongst whom two may be specially mentioned. Father Lafont was nearly for 40 years a great pioneer of scientific education in Calcutta, a popular lecturer, who by his brilliant experimental lectures on the latest developments of science

attracted large audience. For nearly 50 years Father Francotte enjoyed a wide reputation for his meteorological observations. The College has one of the best equipped observatory in Calcutta, which along with a similar one attached to the Presidency College has initiated generations of students to observation of the stellar universe. One other institution which should be mentioned here, is the Bangabasi College, where through the initiative of its founder Principal, Girish Chandra Bose, the college was the first to be affiliated in Botany. As a consequence the majority of the present generation of prominent botanists in Bengal were alumni of this college. Other colleges of the province also took important part in the teaching of science in the province but not enough is known of their activities.

Post-Graduate Teaching and Research Work in the University : During the period 1905-1917, following the *Swadeshi* movement in Bengal, new developments in the educational field took place, which have greatly enlarged the scope and extent of collegiate and post-graduate education in Bengal. During the height of the *Swadeshi*, a large number of students were expelled from schools for taking part in the movement. Mainly to provide educational facilities for these students, that the National Council of Education was started in June, 1906. The educational institutions sponsored by the Council after half a century of very chequered careers, have at last been stabilized and given recognition as the Jadavpur University.

From the beginning one wing of the Council containing men like Taraknath Palit, Nilratan Sircar, wanted immediately to start an institution for imparting training only in engineering and technology. For this purpose,

a society was registered by them, whose aim was to 'inculcate scientific and technical education to the people, calculated to further their industrial progress'. This society started the Bengal Technical Institute in July 1906, at 92, Upper Circular Road which had by then passed into the hands of Taraknath Palit. Taraknath Palit, due to various disheartening causes, came to the conclusion that the country did not want national education. While this controversy was going on in the National Council, the Calcutta University was taking, under the leadership of its great Vice Chancellor, Dr. Asutosh Mookerjee, decisive steps in implementing some of the important recommendations of the 1904 Act. In 1909 provision for Post-graduate teaching came into operation, and in 1917 it culminated in the centralization of the entire Post-graduate teaching under the control of the Calcutta University. From 1908 several university Professorships were founded, in Law, Mental and Moral Science, Higher Mathematics, Ancient Indian History and Culture.

When in 1912, the acute differences of opinion about the future policy of the National Council of Education came to a head, Taraknath Palit decided to sever his connection with the National Council; he requested the latter to vacate within six months, the premises at 92, Upper Circular Road, occupied by the Council's institutions. At the same time negotiations were being carried out by the Calcutta University with Taraknath Palit and Dr. Rashbehari Ghosh for their endowing "chairs" in different science subjects at the University. In 1912, Taraknath Palit offered a donation of Rs. 15 lakhs for the foundation of two chairs, one in Chemistry, and the other in Physics, and for some research scholarships. Later he handed over to the University the premises 92, Upper Circular Road previously

under the occupation of the National Council of Education, and his dwelling house at 35, Ballygunge Circular Road. These two sites have been used to locate the different science departments of the University. In 1913, Dr. Rashbehari Ghosh while still remaining President of the National Council of Education, offered to the Calcutta University a donation of Rs. 10 lakhs, with the income from which the University decided to establish five 'chairs' in Applied Mathematics, Physics and Applied Physics, Chemistry and Applied Chemistry. Later in 1921 a donation of Rs. 5 lakhs was received from Kumar Guruprasad Singh of Khaira, which enabled the University to found five additional 'chairs' including one each in Physics, Chemistry and Agriculture.

Besides the departments of Physics, Chemistry, Mathematics and Botany with their endowed chairs, the University has out of its own funds started other departments like Zoology, Physiology, Experimental Psychology—Pure and Applied, and Anthropology. Regarding the accommodation of the different departments, the principle followed appears to be that the physico-mathematical sciences (Physics, Applied Mathematics and Chemistry) together with Physiology and Experimental Psychology were housed in a series of commodious buildings erected on the grounds of 92, Upper Circular Road and on adjoining areas of acquired lands. While the biological sciences (Botany, Agriculture, Zoology) together with Anthropology, are cramped together in Palit's two dwelling houses, which are not at all suited for laboratory purposes. The University has on the whole shown a step-motherly attitude towards the biological sciences (Botany, Agriculture, Zoology) whose basic importance towards making this country self-sufficient in the matter of food production should not be ignored.

From the beginning, special importance has been attached by the University, as well as by the donors of endowed chairs, to associate with each of the departments of Physics, Chemistry, Mathematics, Botany, corresponding departments for applied studies. The passionate desire which found expression during the *Swadeshi* movement, for encouraging the growth of scientific agriculture and technology in this country, was canalised in this way by the University authorities. The wisdom of this University decision has become apparent especially during the Second World War and subsequent to it, when the important role of technology as the indispensable basis of a modern state is being more and more realized. In the recently started technological industries, like radio, electron engineering and utilisation of energy of nuclear fission, which are indispensable for technological as well as for defense purposes, the usual time lag of about fifty years which used to intervene between the discovery of a new physical principle and its utilisation in engineering industry, is now reduced to between ten to fifteen years. Now results of recent physical discoveries are finding immediate applications in industry. Following this trend in the Science College, from the pure Physics Department, the disciplines of Electronics and Nuclear Physics have separated out and developed rapidly as Institute for Electronics and Radio Physics and as Institute for Nuclear Physics. The Institute of Nuclear Physics, whose initiation and development to the present stage is due almost entirely to the single handed efforts of the late M. N. Saha, expects to receive about Rs 60 lakhs from the department of Atomic Energy during the current Five Year Plan. The Institute of Radio Physics, for whose development Prof. S. K. Mitra, is responsible, as well as the departments of Applied Physics and Applied Chemistry are receiving substantial

recurring and nonrecurring grants from the C.S.I.R. This special financial assistance given to selected departments of the Science College has led to certain unhappy consequences. The two applied departments and the two special institutes are better staffed and better equipped, as compared to the parent departments of Physics and Chemistry. The research and equipment grants received by the latter have remained almost unaltered since 1938, when the present writer left the Science College. Such paucity of resources is sometimes relieved by efforts of individual staff members to secure research grants from the C.S.I.R.

There is an impression abroad that the pure science departments of the University are being financially neglected by the Government of India who are at present only interested in supporting technological education. It is hoped that the newly reconstituted University Grants Committee will be able to remove these anomalies. It is not always remembered that today's technological advances are based upon the utilization of the basic knowledge developed by pure sciences the day before. At present, of the three endowed chairs in the Physics Department, two are attached to the Institutes of Nuclear Physics and Radiophysics, while the third chair is temporarily vacant. Teaching in pure physics is bound to be adversely affected under such conditions. The department of pure chemistry has its full complement of professorial staff but suffers from the handicap of outmoded laboratory equipments and instrumentations. Some of the institutions founded recently in Calcutta are much better equipped.

In the biological departments, specially those relating to Botany, Agriculture and Zoology, no serious efforts have been made to develop their applied sides for which there

are already two endowed chairs. viz. for Applied Botany and Agriculture. Their possibilities for useful cooperation in increasing the yield of food materials so badly needed to make the country self-sufficient are not being realized. Attention has recently been drawn in many articles published in *Science and Culture*, to the necessity of revising the M.Sc. syllabus in Botany, in which at present not sufficient importance is given to the teaching of Physiology, Genetics, and Plant Breeding. The laboratories located at 35 Ballygunge Circular Road do not provide the field stations so necessary for applied teaching. A suggestion has been made recently, for locating some of the post-graduate biological departments of the University at Haringhata. This should be immediately implemented and the funds necessary should be made available. The State Agricultural College, the Animal Husbandry and the Agricultural Experiment Stations of West Bengal are located either at Haringhata or at Kalyani, which is nearby. This will provide a unique opportunity for post-graduate teaching and research in the biological sciences by co-operative efforts of State and University staffs, a practice which has been found very fruitful in the U.S.A.

The aim of teaching imparted in a post graduate department in pure science is two-fold. First to provide a thorough and systematic grounding in the fundamentals of the subject, with corresponding training in laboratory practices. This non-specialized basic training is specially important to those who will take up later teaching in undergraduate and high school classes. Secondly, there should be provision for more advanced teaching in selected topics related to the immediate fields of research, with suitable laboratory courses. These courses are meant specially for students who intend to take up research. For

this purpose it is essential that some of the staff members should be selected for their competence in research. The reputation for research of such staff members will redound to the prestige of the University and attract research workers from outside the State.

At present there is an acute shortage of good science teachers both in the U.K. and in the U.S.A. As a consequence sufficient number of boys and girls at the impressionable age, are not being attracted to science. This has affected the supply of competent graduate scientists which has not been sufficient to meet the growing demands for them in industries, technological research laboratories, and in government scientific services, and in universities. In this country the present output of trained young scientists (M.Sc.) is mainly absorbed in the better paid scientific and industrial research careers, in scientific and technical services, which are much better paid compared to what can be offered by the non-official colleges.

The following table, giving the number of successful candidates in 1951 and in 1956 of the Calcutta University I.Sc. and B.Sc. examinations, shows how rapid has been the rate of increase in the undergraduate classes.

	I.Sc.	B.Sc.
1951	1152	2198
1956	4578	8220

The actual number of candidates who appeared in these examinations is approximately a little over double the number who passed. Lack of accommodation, of funds, of good teachers in sufficient numbers is making the teaching in most of the undergraduate science departments of private colleges highly unsatisfactory, resulting in large wastages of promising student materials,

which in the long run is bound to seriously affect national efficiency.

The need of good science teaching at the college stage is borne out by several recently published reports emanating from the U.S.A., which show that quite a large proportion of scientists who have made their mark in the field of research, had their undergraduate teaching in the so-called small Arts Colleges, which teach only upto the graduate stage. We are told, that probably due to lack of adequate facilities for research, the staff members concentrate their attention on teaching.

There was a tendency noticeable in many places, to assume that a good research worker is necessarily a good teacher. This has not been found to be generally true. Even at the University stage there should be room for really good teachers who may not have achieved distinction in research.

Post-graduate research: We have discussed the function of the university post-graduate department in relation to teaching, research, and also the function of the applied departments. We had to discuss some of the symptoms of the growing pains of the University departments; the problems are not unique to the Calcutta University, but appear with local variations in all countries with large populations which have recently democratised university education as in the U.S.A., Russia and India.

It is a pleasure to turn away from such dismal topics and say something of the research achievement of the post graduate departments of science of the Calcutta University since 1917. The foundation stone of the University College of Science located at 92, Upper Circular Road, was laid by Dr Asutosh

Mookerjee on March 27, 1914 and the post-graduate classes were started in June, 1916. Amongst the first batch of appointments made to the endowed chairs, were some who had already established their reputation as research workers, like Prafulla Chandra Ray, C. V. Raman, and Ganesh Prasad; of these Raman was yet a young man, who while still an officer in the Finance Department had made notable contributions to Optics. Since his appointment to the Palit Chair, he turned out a series of important investigations, whose merit was recognized by his being elected a fellow of the Royal Society of London, and later he became a Nobel Laureate. The foundation of the University College of Science specially provided opportunities to a batch of brilliant young men to strike out along different branches of investigations and to achieve distinctions in them. They all graduated from the Presidency College, and but for the opportunity given to them in the Science College, their talents would have been either frustrated or diverted to other channels. Many of them like M. N. Saha, J. C. Ghosh, J. N. Mukherjee, S. K. Mitra, S. K. Banerjee, G. S. Bose, P. N. Ghosh, P. Ray passed through their adolescence at the time of the *Swadeshi* movement and were attracted to a life of research partly by their aversion to entering the government services and partly by the pioneering scientific researches of J. C. Bose and P. C. Ray. The achievement of the staff attached to the Physics and Chemistry Department was specially outstanding. Raman obtained his F.R.S. for his investigations on light scattering, the Nobel Prize for discovering the Raman effect. M. N. Saha received his F.R.S. in recognition of his theory of thermal ionisation in stellar atmosphere. S. N. Bose achieved fame as co-author of the Bose-Einstein statistics; S. K. Mitra pioneered researches on the upper

atmosphere in this country. He is the author of a standard book on the subject; J. N. Mukherjee's work on surface charges on colloids and J. C. Ghosh's theory of complete ionisation in strong electrolytes received considerable attention at the time of their publications. P. Ray has continued the tradition of P. C. Ray by his investigations in inorganic chemistry specially of inorganic complexes, and of the relation between their coordination numbers and paramagnetic susceptibility. P. N. Ghosh and H. K. Sen will be remembered for their pioneering and painstaking work in establishing the departments of Applied Physics and Applied Chemistry. In the Department of Applied Mathematics, the work of S. K. Banerjee, who later became Director General of Observatories and of N. R. Sen, in whose seminar the younger generation of quantum physicists and theoretical astrophysicists received their training, deserve special mention. G. S. Bose's work on some aspect of Psychoanalytic theory based upon his own extensive practice has received international recognition. Many important investigations of permanent value have appeared from the Departments of Anthropology, Botany, Physiology, Zoology; but the present writer, however, does not feel competent to appraise them.

In other directions outside their laboratories, the contributions of several members of the science departments, specially of those belonging to Physics and Chemistry, have been outstanding. Raman became the first Indian Director of the Indian Institute of Science. He was the founder of the Indian Academy of Science, Bangalore. An Institute has been provided for him for carrying out his special line of investigations. M. N. Saha's many sided interests found scope in his founding the National Science Academy, Allahabad, the Indian Physical Society, the

Indian Science News Association, whose journal, *Science and Culture* was made the vehicle of his many sided propaganda which led to the establishment of the Damodar Valley Corporation and the National Planning Committee organized by the Congress. He was responsible for refounding the Indian Association for the Cultivation of Science and for providing it with commodious buildings on a new site in Jadavpur with modern equipments and enhanced recurring and non-recurring grants. The same is true of the Institute of Nuclear Physics which M. N. Saha founded and stabilized in the face of persistent opposition from several quarters. S. N. Bose has recently become the Vice-Chancellor of the Visva Bharati, while S. K. Mitra has been responsible for founding the Institute of Radiophysics and Electronics. J. C. Ghosh has made his reputation as a scientific administrator of the highest ability; the latest of his many administrative posts is membership of the Planning Commission. J. N. Mukherjee's five years tenure of the post of Director, Indian Agricultural Research Institute has resulted in many fruitful innovations; B. C. Guha, the present head of the Department of Applied Chemistry has served in many extra mural capacities, which include membership of the DVC.

The scientists who so auspiciously started the research programme of the University, are no longer associated with it. Some have moved to other spheres of work, others have retired or passed away. The work of these pioneers is now being taken up by the younger generations of scientists, many of whom have been abroad in different countries of Europe and America, for their final training in research. In each department of science there are some who are engaged in doing significant work. Some of the future leaders of science

in this country may come out from amongst them.

The conditions under which research is being undertaken now are very much different from what they were forty years ago. Raman, Saha, S. N. Bose, S. K. Banerjee and others like them, had made very significant contributions to research before they had been abroad. The problems they tackled were either mainly of theoretical nature or were capable of attack by means of the simplest of apparatus. Of course, it requires a man of genius, like Rutherford, to strip a problem to its essential core, and use the simplest of instruments to obtain results of fundamental importance. In every age there will be men of insight, who can discern such unsolved riddles in Nature, and use the simplest of means to solve them. But the large majority of problems at present in the forefront of science, specially in physical sciences, require the use of highly developed instrumentations, based upon application of electronics, like computers, short electric wave techniques, researches based upon nuclear reactors, million and billions volt accelerators of charged particles. In a country like India, considerable efforts have to be made before it can hope to compete with the highly developed industrial nations, in the production and utilization of these latest expensive tools of research. Research depends now more and more on cooperative efforts. Much of the time and energy of the younger scientists are at present taken up in the assembly of instruments with components imported mainly from abroad, and then they often discover that these apparatus have become outmoded by better instruments devised and constructed elsewhere. But such efforts are not entirely wasted. It helps to build up the technical resourcefulness of the country.

In discussing the progress of teaching and research in science in the century-old University of Calcutta, we have reviewed shortly the development of higher education and research in this province, from the time the British had consolidated their power in Bengal. Before the University started, research flourished mainly amongst a group of Britishers who took pride in being amateur scientists. They were men endowed with unusual curiosity and perseverance; the Asiatic Society was founded by them for discussion and communication of their findings. After the foundation of the University, from 1875 to about 1915 academic research was mainly the work of the Presidency College staff. With the formation of the department of post-graduate teaching, the lead was taken over by the University staff. Even during this period important research work was being carried out, outside the University circle, by members of Government Surveys, of Scientific Services including the Medical Services and by others. Calcutta was from the beginning of the British rule, and still is, the most important centre of scientific research in this country. The output of research by the University can form only a part of the total output from the different scientific organizations in Calcutta. But the basic function of the University, which no other organisation can compete with or replace, is the training of each generation of the youths of the country, to fit them by their character and training for educational, professional and government services, and for their initiation into methods of scientific research. May the University continue to fulfil this basic task with increasing efficiency.*

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Basic Principles of Organisation of Scientific Research

Meghnad Saha

THE movement for organisation of scientific research in the interests of the people has not a long history behind it. If we wish to have a clear grasp of the basic principles of organisation, which must be followed in order that the movement in this country may lead to success, we must not forget the elements in human character which are responsible for the growth of science. It need hardly be told that growth of scientific knowledge since medieval times has been mostly due to private enterprise and the greatest contributions have been almost exclusively due to the efforts of persons of outstanding ability actuated by a spirit of enquiry, enterprise and exploration. But this is as much true of modern as of earlier times. If we take a stock of the fundamental discoveries in science for the last 50 years, we can hardly dissociate personality from any grand achievement. And it seems to be a fundamental axiom that if progress in science, which is the basis of all technical advancement, is to be maintained, the personal element has to be fostered, and given the fullest scope for development.

It appears to be otherwise when we turn to the steps by which great discoveries in pure

science have been translated to industry. It is well-known that almost all the discoveries in the physical and chemical sciences which have given birth to the great industries of steam engine transport, power, fuel, synthetic chemicals, and metals, telegraphy, telephony, radio, automotive engineering—have their roots in researches carried out almost exclusively by persons actuated by the spirit of search after Truth and with no motive for profit, but the methods of big business which translated these to industry appeared almost to run diametrically opposed to the principles of advancement of science. Here success appeared to depend on finance, routine, organisation, secretiveness, and suppression of personality. The great basic discoveries in the medical and biological sciences have followed the same course, though their utilisation by Big Business, has followed somewhat more tardily.

It was first the German industrialists who sensed the advantage of employing scientific men for inventing new processes and improving order ones. The stories of synthetic indigo, and synthetic ammonia, both the result of happy union of scientists and industrialists is so well-known that they need no repetition.

The German State was not behind their industrialists. It is true that whenever any

* Address of Prof. M. N. Saha delivered at the Symposium on Post-war Organisation of Scientific Research in India held under the auspices of the National Institute of Sciences of India, Calcutta, on September 27 and 28, 1943.

new invention or discovery has held out prospects of increase of political and industrial power, States and potentates have not hesitated to take advantage of them. The best known examples are those of the French Governments during the French Revolution, and the various scientific expeditions sent out by the British, French and Dutch Governments to the south and the Pacific Oceans during the eighteenth and nineteenth centuries. But these lessons were apparently forgotten by the end of the nineteenth century, probably owing to the dazzling growth of new industries by private enterprise. It was Germany which first saw the advantage of organising scientific research in the interest of industry and national work and the movement found a concrete expression in the organisations known as the Kaiser Wilhelm Institutes. The object of the organisation was described by Dr. Glum, the general director of the Society in the following words :

"The society's work is to supplement those done by universities, polytechnics, academies, libraries and museums and not to compete with those.

"This is sought to be achieved firstly by undertaking those studies which cannot be done in the above mentioned institutions, secondly, by providing research institutes for those gifted investigators whose time is too much taken up by the routine work of teaching and administration in universities and high schools, and thirdly, by providing places for those young academicians of promise who have taken their doctorates from the universities, but have not yet got any situation where they can develop their natural gifts and carry on further research work in their own lines."

"In order that these ideals may be fulfilled it is necessary that the Society should keep an intelligent watch on the newer currents in scientific investigations and try to further its ideals by creating facilities for new lines of investigation and getting the right man for them. The object has thus been expressed by the President, Adolf V. Harnack, 'The K. W. Society shall

not first build an institute for research and then seek out the suitable man, but shall first pick up an outstanding man, and then build an institute for him'. Experience has often shown that it is rather useful only to call an outstanding man to the headship of an institution, but also to a group of associated institutions at one place and under a loose federation. This should be the case for a very big science like biology, which can be satisfactorily advanced only if the various associated sub-groups work in co-operation for a long time. Therefore it is necessary to unite in one institute experts in different lines who are otherwise quite independent of one another. The directors of these institutes are, therefore, chosen from the ranks of experienced investigators who have retired or given up their teaching work in the universities, high schools, and other places, and the workers are to be chosen from such graduate doctors who have shown exceptional ability in a certain line of work. It has very often happened that after working for some time in the K. W. Institutes, they have qualified for professorships in the universities. In this way, the K. W. Institutes have served a very useful purpose in the educational and scientific life of Modern Germany."

"The group of K. W. Institutes, so far in operation, include two types : one for carrying on pure researches on basic sciences like chemistry, physics, zoology, botany, and medicine ; the other group for applying the knowledge of theoretical sciences and to industry, and thereby making them useful to the economic life of the nation."

The State organisation of scientific research in Germany has undergone wide expansions since the last War, and during the Nazi regime but there is no reason to suppose, as it is often given out, that the basic principles enunciated above have undergone any wide variation. Pure research is as much encouraged as research in applied subjects. e.g., one of the greatest discoveries in Physics, viz., that of Uranium Fission was made in the Kaiser Wilhelm Institute for Physics in Berlin Dahlem in 1939.

THE WORLD WAR OF 1914.

The World War of 1914 was a great eye-

opener, and all other great States of the world as well as the big industrial concerns woke up to the necessity of large-scale organisation of scientific research in the interest of industries, and national welfare, as pointed out by our President*. These organisations, *viz.*, the Department of Scientific and Industrial Research in the U. K. and the National Research Councils in the U.S.A. and other countries have now been working for over a quarter of a century, and it is desirable to make a critical examination of their fundamental policies, organisation and experience. In India, though the movement started during the last War, it was at first confined to agriculture and medicine. The Indian Research Fund Association was started in 1911 and the Imperial Council of Agricultural Research in 1930. The larger question of general organisation of all scientific researches in the interest of the people has been engaging the attention of Indian scientists since 1925, but the public and the Government have been alive to it only during the last three or four years and that also in a spirit of hesitancy and indecision. I consider that our efforts are still in the experimental stage, and unless the new born baby is properly cared for, it may become a permanent invalid.

LORD RUTHERFORD ON THE ORGANISATION OF SCIENTIFIC AND INDUSTRIAL RESEARCH IN INDIA

Fortunately for myself, I found most of the basic principles clearly enunciated in the presidential address which the late Lord Rutherford wrote for the Silver Jubilee Session of the Indian Science Congress and probably for the consumption of the ruler of India. I need hardly remind you that Rutherford was not only one of the greatest experimental scientists

of all times, but he acted as Chairman of the Advisory Committee of the Department of Scientific and Industrial Research of the United Kingdom for eight years from 1930-1938. Coming from a great man and a great scientist and one who had devoted lot of his time to actual direction of the work of organisation of scientific research in the United Kingdom, the observations are entitled of the most serious consideration by all who have to deal with such work. A good deal of his address to the Silver Jubilee Session was devoted to the question of organisation of scientific research in India on the lines of the Department of Scientific and Industrial Research, the necessity for which he foresaw clearly, as a result of his talks with some Indian scientists. The first necessity in this connection was the question of scientific personnel, their recruitment and training and ultimate absorption. To quote his views in his own words :

"This is in a sense a scientific age where there is an ever-increasing recognition throughout the world of the importance of science to national development. A number of great nations are now expending large sums in enhancing scientific and industrial research with a view to using their natural resources to the best advantage. Much attention is also paid to the improvement of industrial processes and also to conducting researches in pure science which it is hoped may ultimately lead to the rise of new industries.

"It is natural to look to the universities and technical institutions for the selection and training of the scientific men required for this development. In India, as in many other countries, there is likely to be a greater demand in the near future for well trained scientific man. With the growth of responsible government in India, it is to be anticipated that the staff required for the scientific services in India and for industrial research will more and more be drawn from students trained in the Indian universities. It is thus imperative that the universities should be in a position not only to give a sound theoretical and practical instruction

* See the leading article in the last issue entitled 'Post War Organisation of Scientific Research in India' by Sir Jnan Chandra Ghosh.

in the various branches of science but, what is more difficult, to select from the main body of scientific students those who are to be trained in the methods of research. It is from this relatively small group that we may expect to obtain the future leaders of research both for the universities and for general research organisation. This is a case where quality is more important than quantity, for experience has shown that the progress of science depends in no small degree on the emergence of men of outstanding originality of mind who are endowed with a natural capacity for scientific investigation and for stimulating and directing the work of others along fruitful lines. Leaders of this type are rare but essential for the success of any research organisation. With inefficient leadership, it is as fatally easy to waste money in research as in other branches of human activity."

TRAINING AND MAINTENANCE OF THE RESEARCH WORKER

"The selection of such potential investigators and leaders is not an easy task, for success in the examinations in science is no certain criterion that the student is fitted for a research career. A preliminary training in research methods for a year or two is required to select those who possess the requisite qualities of originality and aptitude for investigation. A system of grants-in-aid of scholarships to approved students may be required for such post-graduate training. In Great Britain the financial help given by the universities and other educational institutions for training in research is in many cases supplemented by maintenance grants to promising students, awarded by the Department of Scientific and Industrial Research. This system has proved of much value both in developing the research activities of the universities and in providing a supply of component men both for research in pure science and in industry."

You will admit that the whole of this quotation is an eloquent plea for the training of a large scientific personnel in the universities in the methods of pure science under persons of outstanding originality by a large-scale system of grants-in-aid to approved students by the State with a view to their absorption later in industries and national scientific organisations. This maxim has been accepted as a basic one by the D.S.I.R.

RESEARCH IN PURE SCIENCE

The question of encouragement of pure research has unfortunately taken a controversial turn in our Indian organisations, owing to the unfortunate large influx in our most important research bodies of industrialists, and officials, the large majority of whom are unfortunately ignorant of science and incapable of appreciating its spirit. Let us again examine the British experience. It appears that in the earlier years of the inception of the D.S.I.R., the claims of pure research appear to have been in some danger of being swamped by those of applied research. The danger was so great that the Royal Society was compelled to send a deputation to the Lord President of the Council, the Earl of Balfour, under the leadership of the great Physicist Sir J. J. Thomson, then President of the Royal Society who pleaded for the claims of pure research in the following memorable words :

"Pure science is the seed of applied science and to neglect pure science in a thing of this kind would be like spending a very large amount on manuring and ploughing the land, and then to omit the sowing of any kind."

Fortunately there was a Balfour at the head of affairs, and the Cabinet had no difficulty in adopting the principle whole-heartedly. The Lord President in the first report of the D.S.I.R. says :

"We accept the analogy and we trust that the absence of extended reference to pure science in this report will not be taken as indicating our lack of appreciation of its importance."

According to a writer in *SCIENCE AND CULTURE* (Vol. VIII, No. 10, 1943) :

"If the records of investigations financed by the D. S. I. R. of England during the last twenty-five years

are examined, it will be found that nearly three-fourths of the investigations are on "Pure Science". This is of course exclusive of investigations published by such specialized institutions under the D. S. I. R. as the National Physical Laboratory, the Fuel Research Laboratories, the Food Investigation Board, Central Glass Research Institute, most of whose publications are naturally of a practical nature, though even they have very frequently carried out "Pure Science Research."

"The D. S. I. R. has financed schemes on various branches of atomic physics (e.g., Spectroscopy, X-rays), nuclear physics, investigations of the ionosphere, vitamin studies, photo-chemistry, organic synthesis and even sometimes purely mathematical researches."

PLANNING OF PROGRAMMES OF RESEARCH

Let us again quote passages from Lord Rutherford's Address about the organisation, and planning of research :

"In Great Britain, the responsibility for planning the programmes of research, even when the cost is borne directly by the Government, rests with research councils or committees who are not themselves State servants but distinguished representatives of pure science and industry. It is to be hoped that if any comparable organization is developed in India, *there will be a proper representation of scientific men from the universities directly concerned.* It is of the highest importance that the detailed planning of research should be left entirely in the hands of those who have the requisite specialized knowledge of the problems which require attack. In the British organisations there is no political atmosphere but of course the responsibility for allocating the necessary funds ultimately rests with the Government."

Lord Rutherford devoted a good deal of his address to the working of the National Research Institutes—e.g., the laboratories under the Fuel Research Board, Food Investigation Board, the National Physical Laboratory, the Radio Research Board. I am not aware whether the sponsors of these schemes had ever to answer the question which is often asked of us, "Will these researches help us in making money?" or whether they had

to waste half an hour in explaining to industrialists, legislators, and officials who are found in large numbers in many research bodies the difference between biochemistry and biology and such other elementary things as has been unfortunately frequently our experience.

Some of these laboratories dated before the first World War, but most had sprung during the War or just after the War. They were established with a view to serve national as against private industrial interests for which a separate set of bodies known as Research Associations were brought into existence. Though the purposes for which these national laboratories were ushered into existence were specific, the planning of research was left entirely in the hands of expert scientists as mentioned by Lord Rutherford and they were free to carry out any researches on pure sciences if they thought that these would be helpful to their subject. As a matter of fact, most of the methods evolved, say in a subject like food technology, like the refrigerated gas storage of preserving perishable fruit, vegetables, and meat, the large-scale use of vitamins in national foods had their roots in pure researches carried out under the auspices of the Food Investigation Board by professors in their laboratories. It is probably no exaggeration to say that but for these researches, and the methods evolved out of them, and prompt measures taken by the State to implement them, England would have had to beg for peace, with the bread-basket hanging before her like a Tantalus's cup, as Paul Banse had wishfully expected.

Let me place before you the work of another of these national research boards, viz., the Radio Research Board which had financed liberally the researches of Appleton on the

Ionosphere, that of Watson-Watt on reflections of wireless waves from the lower regions, and other professors whose schemes were on pure research

But it is these experiments on pure research, particularly those of Watson-Watt on the low level reflections of e.m. waves which led to the invention of the Radio-locator and according to the testimony of Lord averbrook, the then Air-Minister, this invention has helped substantially in defeating the aironslaugh of the Luftwaffe on England during the terrible days of 1940-1941.

THE NATIONAL RESEARCH COUNCILS

You will probably observe that inspite of the wide difference in the conditions between Germany and England, the basic principles of organisation of scientific research evolved in the two countries at wide intervals of time have been identical. Our President has referred to the organisations known as the National Research Councils in the U.S.A., Canada, and Japan. Of these bodies, the N.R.C. for the U.S.A. appears to have been the model for the remaining bodies though there are important differences. It will suffice therefore to examine the N.R.C. of U.S.A. It must be remembered, however, that conditions in the U.S.A. are widely different from those in any European country. The U.S.A. is pre-eminently the country of private enterprise, of enormous surplus wealth in the hands of private citizens, a large part of which goes to private benefactions. Scientific organisations have grown there largely out of private benefactions of which the Rockefeller and Carnegie foundations, the Research Laboratories of huge industrial trusts, are the most well-known examples. The State was mostly content to watch the growth with benevolent

indifference or forgetfulness. But the attitude had to be abandoned, as a result of the impact of the World War of 1914, and the present War, and now the State is taking as much interest in the control of organisations of scientific research as England or Germany, though of course without much interference with private bodies. It will be interesting to note how in spite of wide variations in conditions the same basic principles for organisation of scientific research have been evalved as in England and Germany. Let me give a brief account.

In the U.S.A., the National Academy of Sciences, under its congressional charter is the supreme body of scientists recognised by the State.

The Charter of the National Academy of Sciences, passed by Congress and approved by President Lincoln in 1863, provides that

“ * * * the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any services to the Government of the United States.”

The National Academy of Sciences has a maximum membership of 450, but the actual maximum has never exceeded 350. Most of the members are senior scientists and the seat of the Academy is in Washington D.C. The use of the Academy by the State, in the words of President Compton was “Spotty” up to the first World War.

The National Research Council was created during the first World War (1916) by the National Academy of Sciences at the request

of President Wilson, as the active agent of the Academy to assist the Government in organising the scientific resources of the country. After the war, it was perpetuated under the following terms :

"1. In general, they stimulate research in the mathematical, physical and biological sciences, and in the application of these sciences to engineering, agriculture, medicine and other useful arts, with the object of increasing knowledge, of strengthening the national defence and of contributing in other ways to the public welfare.

2. To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.

3. To promote co-operation in research, at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress ; but in all co-operative undertakings to give encouragement to individual initiative, as fundamentally important to the advancement of science.

4. To serve as a means of bringing American and foreign investigators into active co-operation with the scientific and technical services of the War and Navy Departments and with those of the civil branches of the Government.

5. To direct the attention of scientific and technical investigators to the present importance of military and industrial problems in connection with the war, and to aid in the solution of these problems by organizing specific researches.

6. To gather and collate scientific and technical information, at home and abroad in co-operation with governmental and other agencies, and to render such information available to duly accredited persons.

Effective prosecution of the Council's work requires the cordial collaboration of the scientific and technical branches of the government, both military and civil. To this end representatives of the Government, upon the nomination of the National Academy of Sciences, will be designated by the President as members of the

Council, as heretofore, and the heads of the departments immediately concerned will continue to co-operate in every way that may be required.

(Signed) WOODROW WILSON."

The White House,
11th May, 1918.

The National Research Council is a co-operative organization of the scientific men of America. Its members include, however, not only scientific and technical men but also business men interested in engineering and industry, and lately Government servants have also been included. The total personnel is 250, and the members are appointed for three years. But if the personnel of the Committees appointed by the N.R.C. be included the number is well over thousand. But the supreme direction is in the hands of the senior scientists constituting the National Academy of Sciences. It will probably shock Delhi to hear how Government members are nominated :

"The representatives of the Government shall be nominated by the president of the National Academy of Sciences, after conference with the secretaries of the departments concerned, and the names of those nominated shall be presented to the President of the United States for designation by him for service with the National Research Council. Each Government representative shall serve during the pleasure of the President of the United States, not to exceed a term of 3 years, and a vacancy from any cause shall be filled for the remainder of the term in the same manner as in the case of the original designation."

During the year 1932-33 the National Research Council was reorganized for the purpose of making its structure simpler and more compact than its former organization had been, but with the retention of the two major features of its earlier plan of organization. These are : (1) the democratic character of the Council, representative of the great

body of scientific men of the United States through affiliation with their national scientific societies ; and (2) the maintenance of Chairman of the several divisions of the Council charged with the scrutiny of their respective fields with a view to the timely encouragement of research in these fields.

Under its present organization the work of administration of the Research Council is carried on by a small group of officers and an Executive Board, with an Administrative Committee which acts for the Board between its annual meetings. The Council itself is composed of nine major divisions arranged in two groups. One group comprises seven divisions of science and technology representing respectively, physics, mathematics, and astronomy ; engineering and industrial research ; chemistry and chemical technology ; geology and geography ; the medical sciences ; biology and agriculture ; and anthropology and psychology. The other group comprises two divisions of general relations, representing foreign relations and educational relations. With these divisions are associated various technical committees, appointed to take charge of projects undertaken by the Council. There are certain other committees, administrative and technical, which affiliate directly with the Executive Board of the Council. The Library of the Council, a limited collection of directories and source books in science, is available for reference services in so far as its facilities extend.

But neither the National Academy of Sciences nor the National Research Council receive grants from the State, but are advisory bodies. But the Global War has changed all that. We quote from an article by H. Grundfest in *Science and Society* :

"All forms of scientific and technological research have expanded greatly since the first World War, particularly in the government and industrial laboratories. Much of the research being done in the present war is being carried on in these laboratories and directly by the army and navy. To co-ordinate all this and to utilize the facilities of the university laboratories there has now been created a new organization which works through the National Academy and National Research Council, but which has money to initiate research and to promote that going on. The top structure is the Office of Scientific Research and Development (O. S. R. D.) ; under it are the National Defence Research Committee (N. D. R. C.) supervising physical and chemical research and the Committee on Medical Research (C. M. R.). About 1,200 scientists are serving on some 100 advisory committees of these bodies. O. S. R. D. has placed over 1,000 contracts with university and industrial laboratories, and has spent about 40 million dollars. In 1943 alone its budget will be 73 million dollars."

SUMMARY OF THE BASIC PRINCIPLES OF ORGANISATION OF SCIENTIFIC RESEARCH

Let me now therefore summarise the basic principles of organisation of scientific research which have been evolved and are followed in all advanced countries of the world. Science is the same all over the world and the really efficient methods of promoting science, of harnessing science to the needs of national work, of industry and general economy, cannot be a function of the latitude and longitude of the place, or a function of the psychological make-up of the individuals who happen to possess the requisite power. The basic principles must be the same, though they may require some modifications in actual application.

(1) The planning of programmes of research, even when the cost is borne by the Government, should be in the hands of research committees or councils composed of members who may not be State servants, but

the majority should be distinguished representatives of pure and applied science, likely to be of use in the subject under investigation and a smaller number of scientific men connected with corresponding industries.

(2) A very large scientific personnel is required for national scientific work, and for manning modern industries ; for this purpose, a large-scale system of grants-in-aid should be given by the State to approved students, to be trained in the methods of pure science in the universities and research institutes under persons of outstanding originality.

(3) There should be no restrictions whatsoever on researches in Pure Science if the research committees consider them desirable

for the fulfilment of their objective ; on the other hand, it is in the interests of the country to develop schools of pure research under persons who have made outstanding contributions to Science.

(4) The administration of all organised research institutions should be in the hands of scientists—as dissociation of power from responsibility, as in unfortunately followed in this country, leads to frustration and failure.

(5) Co-operation of all existing scientific institutions in India : *e.g.*, universities, academies and scientific societies, technical institutions, industrial research laboratories should be secured in all schemes of organisation of scientific research in this country.

রাষ্ট্র ও বিশ্ববিদ্যালয়

প্রফুল্লচন্দ্র রায়

১৯২৬ সালে লর্ড বালফুরের সভাপতিত্বে ব্রিটিশ সাম্রাজ্যের বিশ্ববিদ্যালয় কংগ্রেসের যে অধিবেশন হয়, তাহাতে আমি প্রতিনিধিরূপে প্রেরিত হইয়াছিলাম। প্রথম দিনের আলোচনার বিষয় ছিল—‘রাষ্ট্র ও বিশ্ববিদ্যালয়।’ আমি এই প্রসঙ্গে বলিয়াছিলাম—

“আমি এই বিষয়ে কিছু বলিবার জ্ঞান প্রাপ্ত হইয়া আসি নাই। কিন্তু আমি দেখিতেছি যে, আমাদের হাই কমিশনার (তিনি আমার ভূতপূর্ব ছাত্র) অসুস্থতার জ্ঞান আসিতে পারেন নাই, আরও কয়েকজন সদস্য অনুপস্থিত আছেন। সেই কারণে আমি আপনাদের সম্মুখে বক্তৃতা করিতে উপস্থিত হইয়াছি। এখানে বক্তৃতা করিবার সুযোগ লাভ করা আমি সৌভাগ্য বলিয়া মনে করি।

“১৯১২ সালে প্রথম সাম্রাজ্য বিশ্ববিদ্যালয় কংগ্রেসে আমি বক্তৃতা করিবার জ্ঞান আহুত হইয়াছিলাম। সুতরাং এখানে আমি নূতন নহি। আমার যতদূর মনে পড়ে, আমাদের চেয়ারম্যান মহাশয়ও সেই সময়ে কোন এক অধিবেশনে সভাপতিত্ব করিয়াছিলেন।

“আজ আমার বক্তৃতার প্রধান উদ্দেশ্য, বাংলা দেশে শিক্ষার অবস্থা কিরূপ শোচনীয় হইয়াছে,

তাহাই ব্যক্ত করা। আমাদের সম্মানিত সভাপতি মহাশয় অক্সফোর্ড ও এডিনবার্গ দুইটি বিশ্ববিদ্যালয়ের চ্যান্সেলর। আমি আশা করি তিনি যে সব সাংগর্ভ কথা বলিয়াছেন, তাহা ভারত গবর্ণমেন্ট ও বাংলা গবর্ণমেন্ট বিশেষ ভাবে বিবেচনা করিয়া দেখিবেন।

“আপনারা জানেন, ১৯১৯ সালের মটেও চেমসফোর্ড শাসন সংস্কার ভারতীয় বিশ্ববিদ্যালয় সমূহের অবস্থা কি ভাবে পরিবর্তিত করিয়াছে। উহার দ্বারা বিশ্ববিদ্যালয়গুলি প্রাদেশিক প্রতিষ্ঠানে পরিণত হইয়াছে। কলিকাতা বিশ্ববিদ্যালয়ের পক্ষ হইতে যখন আমরা ভারত গবর্ণমেন্টের নিকট সাহায্য প্রার্থনা করি, তাঁহারা আমাদেরকে বাংলা গবর্ণমেন্টের নিকট যাইতে বলেন; অতীতকে বাংলা গবর্ণমেন্ট মেইনটেনী ব্যবস্থার দোহাই দেন। সুতরাং আমরা উভয় সঙ্কটে পড়িয়াছি। গবেষণা কার্যের জ্ঞান ব্যক্তিগত দানের উজ্জল দৃষ্টান্ত বাল্মোরে ইনষ্টিটিউট অব সায়েন্স। প্রধানত বোম্বাইয়ের প্রসিদ্ধ ধনী পরলোকগত মিঃ জে. এন. টাটার বিরাট দানেই উহার প্রতিষ্ঠা। বোম্বাই বহু লক্ষপতির আবাসস্থল। যদিও বাংলাদেশ বহু ধনী সম্ভানের গর্ব করিতে পারে না, তবুও সে বিষয়ে আমরা একেবারে দরিদ্র নহি। আমাদের বিজ্ঞান কলেজ দুইজন মহানুভব ধনীর দানে প্রতিষ্ঠিত।

প্রথমত স্ত্রীর তারকনাথ পালিত। তিনি মৃত্যুর পূর্বে একলক্ষ ১৫ লক্ষ টাকা দান করিয়া যান। উহা প্রায় একলক্ষ পাউণ্ডের সমান। তিনি আইন-জীবী এবং এই দানের দ্বারা তিনি তাঁহার সম্মান-দিগকে তাহাদের প্রাপ্য অংশ হইতে বঞ্চিত করিয়াছিলেন, কেন না বলিতে গেলে তাঁহার সর্বস্বই তিনি বিজ্ঞান কলেজ প্রতিষ্ঠার জন্য দান করেন।

“ভারতের অগ্র একজন শ্রেষ্ঠ আইনজীবী তাঁহার দৃষ্টান্ত অনুসরণ করেন। তাঁহার নাম স্ত্রীর রাসবিহারী ঘোষ। তিনি বিজ্ঞান শিক্ষার জন্য প্রায় দেড়লক্ষ পাউণ্ড দান করিয়া যান। ভারতীয়দের নিকট হইতে আমরা যতদূর সম্ভব সাহায্য পাইয়াছি। তাঁহাদের দানের পরিমাণ মোট প্রায় ৬০ লক্ষ টাকা।

“কিন্তু যখনই আমরা ভারত গবর্ণমেন্ট বা বাংলা গবর্ণমেন্টের নিকট অগ্রসর হই, তাঁহারা অর্থা-ভাবে অজুহাত দেখান,—অথচ বড় বড় ইম্পি-রিয়াল স্কীমের জন্য জলের মত অর্থব্যয় করিতে তাঁহাদের বাধে না। গবর্ণমেন্টের এই কার্পণ্যের সমালোচনা বহুবার আমাকে করিতে হইয়াছে। আমাদের সঙ্গে উপস্থানের ‘অলিভার টুইষ্টার’ মত ব্যবহার করা হয়। আমি আশা করি সভাপতি মহাশয় যে সারগর্ভ বক্তৃতা করিয়াছেন, তাহা বেতারযোগে প্রচারিত হইবে এবং রয়টার উহা ভারতে প্রেরণ করিবেন; তাহা হইলে ঐ বক্তৃতা সমস্ত সংবাদপত্রে প্রকাশিত হইবে এবং উহা ভারতের সর্বত্র পঠিত হইবে। ভারত ব্রিটিশ সাম্রাজ্যের একটি প্রধান অংশ। সুতরাং উচ্চতর বিজ্ঞানের প্রসার সম্বন্ধে একই নীতি সাম্রাজ্যের

অগ্রাঙ্গ অংশে ও ভারতে কেন অনুসৃত হইবে না, তাহা আমি বুঝিতে অক্ষম।

“আমি বিশেষ ভাবে একটি তথ্যের প্রতি সভার দৃষ্টি আকর্ষণ করিতেছি। এই ভারতীয় জাতি অতীতে গৌরবের উচ্চ শিখরে আরোহণ করিয়াছে। মাক্সমুলার একস্থলে বলিয়াছেন যে, হিন্দুরা যদি আর কিছু না করিয়া ইয়োৰোপকে শুধু দশমিক পদ্ধতি দান করিত—উহা আরবীয় নহে, আরবেরা কেবল মধ্যস্থল রূপে ইয়োৰোপে ঐ বিজ্ঞা প্রচার করিয়াছেন,—তাহা হইলেও, ভারতের নিকট ইয়োৰোপের ঋণ অসীম হইত। হিন্দুদের অন্তর্নিহিত মানসিক শক্তি যে অসাধারণ অতীতে স্মৃতিমণ্ডিত এই সুপ্রাচীন বিশ্ববিদ্যালয়ের নিকট তাহা অজ্ঞাত নহে। হিন্দু প্রতিভা সুযোগ ও উৎসাহ লাভ করিলে কি করিতে পারে, তাহার যথেষ্ট প্রমাণ আপনারা পাইয়াছেন। এই প্রসঙ্গে, পারাশর্যে, রামানুজান এবং জগদীশচন্দ্র বসুর নাম করিলেই যথেষ্ট হইবে। তাঁহারা সকলেই এই কেশ্বিজ বিশ্ববিদ্যালয়েই শিক্ষালাভ করিয়াছিলেন।

“আমি মনে করি, দুইটি কারণে এখানে বক্তৃতা করিবার আমার অধিকার আছে। পূর্বেই বলিয়াছি, আমাদের সম্মানিত সভাপতি মহাশয়ের নেতৃত্বে আমি ইতিপূর্বে আর একবার বক্তৃতা করিয়াছি। দ্বিতীয়ত প্রায় অর্ধশতাব্দী পূর্বে, উত্তরাঞ্চলে প্রসিদ্ধ বিশ্ববিদ্যালয়ে (এডিনবার্গে) আমি ছয় বৎসর ছাত্ররূপে শিক্ষালাভ করিয়া ছিলাম। সভাপতি মহাশয় বর্তমানে ঐ বিশ্ববিদ্যালয়ের চ্যান্সেলর। সুতরাং রাসায়নিকের ভাষায় বলিতে পারি, আমি তাঁহার সঙ্গে দ্বিবিধ বন্ধনে আবদ্ধ।

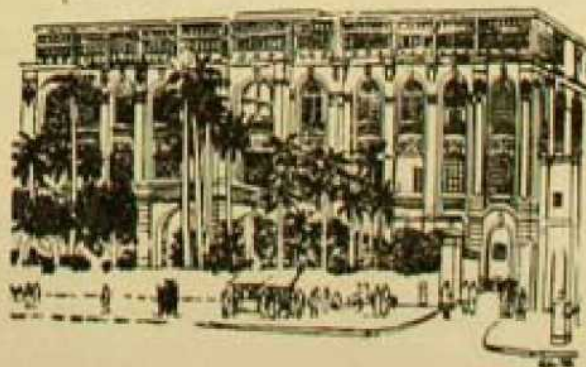
“আমি আশা করি ভারত গবর্ণমেন্ট অথবা দুই ভাগ মাত্র সাহায্য পাইয়াছি। অবশিষ্ট বাংলা গবর্ণমেন্ট এখন বিশ্ববিদ্যালয় বিজ্ঞান শতকরা ৯৮ ভাগ সাহায্য আসিয়াছে আমাদের কলেজের সাহায্যার্থ অগ্রসর হইবেন। আমি দেশবাসীর নিকট হইতে।”*

হিসাব করিয়া দেখিয়াছি, যে বিজ্ঞান কলেজের *আচার্য প্রফুল্লচন্দ্র রায়ের ‘আত্মচরিত’ হইতে সংগৃহীত
জ্ঞান আমরা গবর্ণমেন্টের নিকট হইতে শতকরা (পৃ: ২০৭-২১০)।

[This article expresses views of P. C. Ray regarding Government funding towards the development of this University. This address was delivered on the first day of the University Congress in 1926 and the topic was 'The Government and the University'. In his address P. C. Ray mentioned that the financial contribution from the Government for University College of Science was only 2% while the rest 98% came from Indian citizens. This surely sets a pointer towards solving the perpetual problem of paucity of funds needed for advancing teaching and research.]

SECTION : 2

Platinum Jubilee Celebration :
The Inaugural Function



A Note on the Programme on Celebration of Platinum Jubilee of University Colleges of Science, Technology & Agriculture

TO put on record, we should give a glimpse of the programme for celebration of Platinum Jubilee of the foundation of the University Colleges of Science, Technology & Agriculture.

On 27 March, 1989, Flag Hoisting Ceremony at two Campuses 92, A. P. C. Road and 35, B. C. Road was organized. Inaugural function took place at the auditorium of the Saha Institute of Nuclear Physics, 92 A. P. C. Road, Calcutta-9. Welcome address was delivered by Prof. (Mrs.) Bharati Ray, Pro-Vice-Chancellor (Academic Affairs). Introductory speech was delivered by Prof. R. K. Poddar, Ex-Vice-Chancellor, Calcutta University. Inaugural address was given by Sri Benoy K. Chaudhuri, Hon'ble Minister-in-charge, Land & Land Reforms, Govt. of West Bengal. Dr. A. P. Mitra, F.R.S., Director General, CSIR, Govt. of India, addressed the august audience as the Chief Guest. Prof. Bhaskar Ray Chaudhuri, Vice-Chancellor, C.U. and President, Organizing Committee, delivered his valuable speech on the occasion. Prof. D. K. Sinha, Pro-Vice-Chancellor, Business Affairs & Finance, C.U. gave vote of thanks.

Prof. M. M. Chakraborty, Ex-Vice-Chancellor, Jadavpur University, opened an exhibition in the Science College, designed and conducted by the teachers and students of various departments of the Science College.

A seminar on 'Development of Science & Technology—Role of University' was organized at Saha Institute of Nuclear Physics auditorium on 27 March after recess. Eminent educationists, scientists and alumni of the Science College, namely Prof. B. D. Nag Chowdhury, Prof. P. K. Bose, Dr. A. P. Mitra, Director CSIR, Prof. (Mrs.) Asima Chatterjee, Prof. M. M. Chakraborty, Prof. R. K. Poddar, Dr. D. Banerjee, Managing Director, Eskon Consultant (Private) Ltd., Prof. G. K. Manna, Kalyani University, Dr. A. M. Ghosh, V.E.C.C., Calcutta, participated in the seminar. We are grateful to all of them.

On 28 March, 1989, an exhibition on science was opened at 35, Ballygunge Circular Road, designed and organized by various departments. The science exhibitions at the Science College 92, A. P. C. Road and at 35, Ballygunge Circular Road were visited by students of various colleges, guardians of the students and public at large, and were very much appreciated by all. On the same day a get-together of the Alumni (Old meets New) was organized at the Kennedy Hall, 35, Ballygunge Circular Road. Many retired teachers of the Science College were kind enough to participate in the get-together function. On this occasion, Prof. N. N. Dasgupta, Prof. S. K. Mukherjee, Prof. P. K. Bose, Prof. Parimal Ghosh, Prof. S. W. Shah, Prof. M. K. Dasgupta, Prof. A. K. Sharma, Prof. (Mrs.) Asima

Chatterjee, Prof. M. M. Chakraborty, Mr. Udayan Chatterjee, Dr. A. S. Bhaduri, Dr. B. K. Mukherjee, Dr. S. P. Sarkar, Prof. N. K. Bose, Prof. B. B. Roy, Prof. Sunil Mukherjee, Prof. S. N. Roy spoke. In this get-together one representative of C.U. Supervisory Staff Association, one from Employees' Association, one representative of Research Scholars Association and one representative of Students' Union also took part.

On 29th March, 1989, selected research papers authored by Research Scholars and Young Teachers (Pure Science & Bio-Science group) were presented. Distinguished retired teachers of various disciplines acted as experts and judges. On 30 March, 1989, selected research papers were presented by Research Scholars and Young Teachers of Technology stream.

On 31st March, 1989, a seminar on "Frontiers of Science" was organized at Saha Institute of Nuclear Physics auditorium. Prof. Bhaskar Ray Chaudhuri, our Vice-Chancellor delivered the welcome address. Among the speakers, we had the privilege of having persons like Prof. Yash Pal, Chairman, U.G.C., New Delhi, Dr. S. K. Lahiri, C.G.C.-R.I., Calcutta, Dr. J. K. Ghosh, Director, I.S.I., Calcutta, Dr. B. K. Sinha, Director, V.E.C.C., Calcutta, Prof. Amitabha Bagchi,

IIM, Calcutta, Prof. Arun K. Sharma, Calcutta University. Vote of thanks was given by Prof. S. P. Mukherjee, Dean, Faculty of Science. We express our indebtedness to them all for their kind participation in the seminar and making it a success.

After the tea break, valedictory function was held. Our Vice-Chancellor delivered the welcome address. Prof. Yash Pal, Chairman, U G. C., distributed the prizes among the recipients who came out with distinction for their research papers and the students of various departments who distinguished themselves as best writers in the essay competition organized on the occasion. Prof. Yash Pal delivered his address after the prizes were distributed.

Mr. T. V. Rajeshwar, Chancellor, University of Calcutta, delivered the valedictory address.

In this week-long academic programme, cultural programmes were also organized in the evening of 27th March when artists like Hemanta Mukherjee, D. Litt, Suprava Sarkar and other eminent artists took part.

[At the time of the release of the Commemoration Volume, at the end of one year programme, series of lectures on important science topics by eminent scientists of various disciplines have been proposed to be organized.]

Welcome Address

Bharati Ray

Mr. Vice-Chancellor, Honourable Minister, Sri Benoy Krishna Chaudhuri, Dr. Mitra, Pro-Vice-Chancellor, (Business and Finance), distinguished guests, my colleagues—teaching and non-teaching and friends.

It is my proud privilege to welcome you all on behalf of the University of Calcutta to the inauguration of the Platinum Jubilee of the University Colleges of Science, Technology and Agriculture.

It is an occasion to recall with pride and pleasure the great heritage of the University College of Science, where distinguished personalities like Acharya Prafulla Chandra Ray, C. V. Raman, Meghnad Saha, Satyendranath Bose, Sisir Kumar Mitra, Girindra Sekhar Bose and many others had once taught, carried out researches and discovered scientific truths which have been a source of inspiration and strength for succeeding generations. It is the first ever institution in India to teach science

and promote scientific research at the post-graduate level. And it is in this context that we remember with deep gratitude Sir Asutosh Mookerjee's untiring efforts which led to the establishment of the Science College in 1914.

Decades have since passed and after a glorious record of achievements we are today celebrating the completion of seventy five years of the college. We have ahead of us a year-long programme to observe this important occasion and, to start with, we have a week-long programme of seminars, a science exhibition, invited lectures by distinguished guest-speakers, and a prize distribution ceremony to distribute prizes to scholars, teachers and post-graduate science students excelling in their presented research papers and articles.

I once again welcome you all and invite you to participate in the programmes of the Platinum Jubilee Celebration of the University Colleges of Science, Technology and Agriculture.

Introductory Note

R K Poddar

WE are today celebrating a momentous event in the history of 132 years old Alma mater. Seventyfive years ago on this auspicious day, that is on 27th March, 1914, Sir Asutosh Mookerjee laid the foundation stone of the University Colleges of Science & Technology at this campus just four days before his retirement from the eight-year long tenure as Vice-Chancellor. Later on another campus of this University College was built up at Ballygunge and a separate faculty of Agriculture was included. If we look back, and this is a fit occasion for looking back, we would see that this launching of University Colleges of Science & Technology was far from a smooth affair. On the contrary it was preceded by the decade-long protracted struggle by our patriotic educationist to persuade and pressurize the then alien and unfriendly government to agree to convert our University from a mere examining body to a true national centre of post-graduate study and research. The setting up of the University College of Science was the most important component of that struggle. For more than half a century since its inception in 1857 our University's sole academic activity consisted in conducting examinations only from Matriculation upward of students from affiliated schools and colleges of the sub-continent ranging from Afghanistan to Burma which

was under the British Empire. Contact with European enlightenment during the nineteenth century convinced our national leaders like Raja Rammohun Roy and Iswar Chandra Vidyasagar that we could also remove our backwardness and take our proper place among the advanced nations of the world if we had our own centres of modern education for our own citizens. Events following the ill-fated partition of Bengal in 1905 clearly indicated that the self-reliant socio-economic development of our country through absorption of science and technology was perhaps the last thing that the imperialist government desired.

Patriots of Bengal did not of course passively accept this gloomy situation. Towards the end of 1912 the most notable thing happened, Sir Tarak Nath Palit, an eminent lawyer, donated to the University land and money worth a sum of Rs. 13 Lakhs towards the foundation of the University Colleges of Science & Technology so that two professorships one each in Physics and Chemistry could be maintained, out of the income of the endowment. In 1913 another distinguished lawyer Sir Rashbehari Ghose came forward with an offer of Rs. 10 Lakhs so that four more professorships could be created one for each of the subjects, namely Applied Mathe-

matics, Physics, Chemistry and Botany with special reference to Agriculture. Armed with this magnificent gift Sir Asutosh Mookerjee could ultimately overcome the governmental apathy and fulfilled his life-long ideal of establishing a teaching university of Calcutta. The first incumbents were, as you know, Chandrashekhar Venkataraman for Physics and Prafulla Chandra Ray for Chemistry as Palit Professors. Ganesh Prasad, Shankar Purushottam Avarkar, Debendra Mohan Bose and Prafulla Chandra Mitra occupied the first Ghose Professorships in Applied Mathematics, Botany, Physics and Chemistry respectively. Thanks to his persuasive skill and magnetic personality; Sir Asutosh could attract the first distinguished scientists who could have added lustre to any university in the world. The Twenties, the Thirties and the Forties were the periods of reform, reorganization and full flourishing of our University College. In fact, this period may be called the golden age of our University and also of the University College. C.V. Raman received the Nobel Prize, Satyendra Nath Bose developed his epoch-making Bose-Einstein Equation, Professor Meghnad Saha formulated the famous Thermal ionization Theory, Sisir Kumar Mitra made his pioneering contribution in Ion Space research. Other distinguished scientists who adorned our professorships during this period included Gnanendra Mohan Mukherjee, Priyada Ranjan Ray, Pulin Behari Sarkar, Biresh Chandra Guha and Jogendra Chandra Bardhan in various branches of Chemistry, Nikhil Ranjan Sen and Fredericks Levy in Applied and Pure Mathematics, Paul Groom and Prabhat Chandra Sarbadhikari in Botany and Nagendra Nath Ganguli and Pabitra Kumar Sen in Agriculture and Himadri Kumar Mukherjee in Zoology. We most gratefully remember these teachers today because it was

their devotion and persistent struggle for excellence that this raised the standard of study and research here to the international level and that also inspite of the paltry salary and uncertain tenures of those days. We remember them because they were also the pioneer especially Prafulla Chandra Ray, Meghnad Saha, Biresh Chandra Guha and Upendra Nath Brahmachary amongst them who brought academic science and technology to the service of economic development in the fields of industry, agriculture and medicines and thus initiated the culture of self-reliance which the whole nation emulated. Since 1915 our University College had been able to keep pace with modern development by introducing new avenues of study and research especially in interdisciplinary fields.

Quality of our teaching, I am proud to say, is appreciated not only in India but also abroad. Even at this moment quite a few of our Alumni hold top positions in Europe and America. I have recently gathered that our students usually win 30 to 40 per cent of openings of Tata Institute of Fundamental Research in Bombay, and Indian Institute of Science, Bangalore in their admission tests conducted on all-India basis. Performance of our students is also very commendable in the national educational tests (NET) conducted for research fellowships by the UGC and the CSIR. University College also nurtured several research institutes. This very Saha Institute of Nuclear Physics grew out of the Palit Laboratory of Physics. The Institute of Jute Technology was set up in collaboration with Indian Jute Mills Association. We are very glad that in this Platinum Jubilee year our University is actively considering the setting up of an Institute for Atmospheric Research and an Institute of Genetic Engi-

neering and Biotechnology. Several University departments and sections now enjoy the status of the UGC centres for advance study. These include the Institute of Radio Physics and Electronics, Centre for study of Natural Product, Centre for Chromosome Research *etc.* New departments and study programmes like Computer Science, Marine Science, Electronic Science, Opto-electronics, Environmental Science, Biophysics and Molecular Biology have been started in recent years. During the post-independence years the number of universities in India increased from about 15 to 115 and that of research institutes from a handful to about 350. Financial worries and governmental apathy of Sir Asutosh's days are now past memory. But we must admit that we are finding it difficult to maintain the standards of excellence set up by our predecessors with so meagre facility. Here I will only mention that after everything is said and done on this auspicious occasion, the quality of a university and also our University will ultimately depend on the

quality of its teachers. Only good teachers can develop talents and inspire students to take up challenges of the expanding frontiers of science & technology. I wish to conclude by a quotation from the gift deed of our original donor. It said that the duties of the university professors should be "(a) to carry on original research in special subjects with a view to extend the bounds of knowledge and to improve by application of his researches the arts, the industries, the manufactures and the agriculture of this country; and (b) to stimulate and guide research by advance students and generally to assist them in post-graduate work so as to foster real learning amongst our own men." Now these principles enunciated more than 75 years ago are equally valid today, and I am certain that they will remain valid 75 years hence. And if we continue to uphold these principles as Sir Asutosh was doing then, we will be able to remain as the premier centre for advancement of scientific and technological learning in the service of our country.

Inaugural Address

Benoy Krishna Chaudhuri

THE University celebrates this year the Platinum Jubilee of its Colleges of Science, Technology and Agriculture. The foundation stone of the College was laid on March 27, 1914 and it became 75 years old on March 27, 1989. The College had a modest beginning with one faculty, the faculty of science comprising four departments, the departments of Mathematics, Physics, Chemistry and Physiology. In course of the 75 years of its existence it has added new department to cater to the needs of the country. It has, at present, three faculties—the faculties of science, technology and agriculture and 24 departments. About 1000 students and 300 research fellows study in this college today under the guidance of 500 faculty members. The college has been a unique institution for the pursuance of learning of science in the University. It has started at a time when there was hardly any opportunity to study science in India at an advanced level. The then visionaries of Bengal who were at the helm of affairs of this University took this important step under the leadership of Sir Asutosh Mookerjee to create an institution where Indian scholars could study Science and could work to unfold the mysteries of nature. The College had as its staff from the very beginning scholars of outstanding merits whose works had become the legends in our history of science. Names of Sir Jagadish Chandra Bose, Acharya P C Ray, C V Raman, P Ray, S N Bose, Meghnad Saha, S P Mitra, N R Sen, B C Guha have inspired generations of Indian scientists and remained as ideal even today. The College has also all

along followed the paths laid down by these Generals, namely, the post-graduate study can only flourish when it is followed up by research. The only Nobel prize in science earned by an Indian was by a teacher of this College—C V Raman. In later years teachers of this College have earned recognitions in the form of fellowships of the foreign and national science societies and as an academic—Bhatnagar, Jawaharlal Nehru Fellowships and many other national awards. Students of this College had been the leaders of scientific activities in many institutions of the country. The College can legitimately be proud in this Platinum Jubilee Year for its contribution to the development of science and technology of this country. In this Platinum Jubilee Year, as the College looks at the past, it has also to plan its future. The tradition set by the founder has to be kept up. The research as needed by the society has to be pursued. Laboratories should be properly housed and equipped with modern equipment. Teachers are required to lead the activities of the College so that the contribution to the progress of the nation becomes visible. New subjects of study have to be introduced. New frontiers of research have to be opened. I feel sure from my knowledge of the past that the College will live up to the ideal and with new achievements of highest international standard will add a new glorious chapter to the history of this esteemed Institution.

With these few words I formally inaugurate the session. Thank you all.

University College of Science : Illustrious Past and Promising Future

A. P. Mitra

ALTHOUGH I visit the Science College fairly frequently I am particularly pleased to be here today because of its special nature, to be there at the time of the celebration of a University to which I owe a good deal of my scientific career. I would start with a comment that Professor Kothari made on the occasion of the Diamond Jubilee Celebration of the Science College. I quote—"For the resurgence of advanced study on research in science in our country we owe to Science College more perhaps than any other institution. The great names that immediately come to my mind—and these are a few out of many—are Sir Asutosh Mookerjee, Prafulla Chandra Ray, Jagodish Chandra Bose, Saha, Raman, N. R. Sen, Satyen Bose—what a galaxy of merits". This was a comment made by Professor D. S. Kothari, a doyen of our scientific research and edacational system, and I think, it sums up what the scientific community feels about the Science College.

Professor Poddar mentioned about the golden age of the Science College—Twenties to Forties—I would like to extend it to Fifties—and I would like to go a little bit further—it was not only the golden age for the country, it was more like Renaissance—a Renaissance of the kind that we have seldom seen in recent years in India. It was a Renaissance we seldom see in any country—a Renaissance in which we had a linkage of

the most outstanding talents—Science, Philosophy, Literature, Religion, Politics interacting with each other. Great names in almost every area—ideas of Vivekananda, Ramakrishna, Tagore, then Nazrul Islam and Bankim Chandra, Politicians like Gandhi, Subhash Chandra Bose—a whole range of them along with the scientists co-existing at about the same time—for two or three decades. We have also now great names in science. We have great names in politics. But I do not think we have that well rounded total development of an interacting nature that one can truly call a Renaissance happening any more. If one asks why this happened at that time, one finds that the University had a very major role in it. And Science College certainly had a part in that. In the thirties, in Science, there were giants like Raman, Saha, Mahalanobis, Ganesh Prosad, P. C. Ray, S. K. Mitra ; in Humanities Abanindra Nath Tagore (Nageswari Professor of Fine Arts), Suniti Chatterjee, Bhandarkar, Radhakrishnan, and even Tagore as a Special University Professor. Now one learns a few things here. One learns that it is possible to bring together giants in different disciplines under one umbrella, if one goes a little out of the way. Sir Asutosh Mookerjee did precisely that. In many ways this period from the science point of view, reminds us of the pre-war Cavendish Laboratory. A few years ago Sir Harrie Massey, a friend of ours, showed a picture of the young students and faculty

working in the Cavendish Laboratory in the Thirties with him. Most of them became Nobel Laureates. If one looks at the period of the Science College at that time, it is not much different. Now why did this happen? I think it was the care and feeling for excellence. Again when I was looking at the beginning of the Physics Department I find that the first group of scientific staff was appointed in 1916. Look who they were—Professor C. V. Raman, Research Scholars S. N. Bose, Meghnad Saha, Assistant Professor S. K. Mitra. Now if you look back, Raman became an FRS in 1924 and a Nobel Laureate in 1928. Saha I think, became an FRS in 1928. Bose and S. K. Mitra later. So all of them became Fellows. It is very remarkable that from one University and from one department, you had four FRSs at that time and one Nobel Laureate—something very hard to beat.

I joined the M.Sc. class here in this University in 1947/48 and then a couple of years later came under S. K. Mitra for research for the doctorate degree. I think these were the hay days in that particular field in any way. The reputation of the Science College was very very high. I still remember when under the Colombo Plan I got a fellowship to go to Australia, in 1951 I think, and then shortly after I submitted my thesis here, the question that was asked in Australia was "Well, why did you leave Professor S. K. Mitra's Laboratory to come here". It was that kind of reputation. We had as our teachers in the M.Sc. class three Professors—S. N. Bose, Meghnad Saha, and S. K. Mitra. I mention this to point out that it was then possible to have teaching of that level.

At that time the University had thought of diversifying. Physics was no longer consi-

dered a classical physics of the kind that other universities were talking about. Already the Institute of Nuclear Physics had been set up. The Departments of Radio Physics and Electronics had been installed. There were already excursions into newer areas of Physics in which there was a good deal of components of other disciplines including engineering. The need for technology teaching was recognized very early in this University. I find that the Department of Applied Chemistry was set up in 1920, and then the Department of Applied Physics in 1925 and that was the first post-graduate Course in Applied Physics in India. Later on, other departments, according to the needs, came up. The most important thing is that even so long ago almost immediately after the origin and the initiation of the Science College, technology was thought of, thought of not in the way that we think about technology now; I think, it was in a more comprehensive way. That is technology not in its technological form, but technology in a scientific form, science in relation to technology, the scientific basis of technology which is very very important. I have seen, later on, that people who came through the Applied Chemistry and the Applied Physics streams here had a lot more physics, mathematics and basic science background than the students of traditional engineering universities, engineering Colleges. That kind of training now has become possible through IITs and the Institute of Science. So this science-based technology concept was probably one of the first and major inputs of this system.

Now one might ask what has happened to the Science College since then? Have there been remarkable people? If one looks at the list of recipients of Shanti Swarup Bhatnagar awards, instituted by CSIR many years

ago, the first thing one finds is that a very large percentage of the awardees are from the University community even though the investment is fairly low ; and of that university component, a substantial number comes from the Calcutta University. Then the schools of research have gone up with the 'gharana' system that Professor Menon talks about. Well, there are very strong groups ; strong schools of research have been set up here and they are very effective. Professor Poddar mentioned about the National Junior Research Fellowship—NET Examination last year, the first one that was held jointly with UGC. Out of the 1500 or so that we selected from the examination jointly between CSIR and UGC, the largest number came from the Calcutta University. The second largest from Delhi University. I forgot the number. I think, it was about 250. I think, in almost all areas, they were either at the top or nearing the top—almost in every subject—Physics, Chemistry, Earth Sciences, and Biological Sciences. So, the lack of talent is not the question ; it is not the problem. Talent exists. This is one way of seeing them ; they are spreading all over the country and that is why often they are not always visible.

I would like to mention one or two points, before I sit down, about what can be done in future in regard to the institution such as the Science College which has such a record and tradition. One is the question of funding. Research and Development investment in our country now is about 1% of GNP. There is a commitment of increasing this investment to over 2% by the end of the Eighth Plan.

So there will be more money available for Research and Development, hopefully. Even if it is 2%, it is a very large amount of money ;

but of that R & D investment—something like Rs. 300 Crore—the amount available to the university community is very low. It is very difficult to estimate the amount available to the universities because much of the university support comes from the other agencies—from out of their funds. But I do not think it is more than 4 or 5% ; that is not a small amount. CSIR's component is 7.5%. In fact, the component between industrial research and Defence R & D itself is something like 50%. One hopes to increase the university component or percentage in future either directly or through more liberal funding from the various agencies. What role can CSIR play in that ? We have just introduced a Visiting Research Associateship for the university community and for the industrial R & D community. It would be announced officially very soon and advertised asking for people who would like to be considered for that purpose. It will be a three year term—more like in the Trieste International Centre for Theoretical Physics. During the vacation period they would come and work in some of the CSIR laboratories. All the expenses will be paid by CSIR during that period—not more than 60 days in a year for a three year period. The entire facilities of the laboratories will be available to them just as they are available to the senior scientists of our laboratories. We have also taken a decision of having a few joint University—CSIR Research Centres in the campuses of the universities to be run by joint management committees. Right now we are going through the exercise of deciding on the areas to be covered.

Then there are a number of major programmes that have come up or will come up in future on various kinds of technology

missions. You know the component of the university research is here rather low and can be increased by support. We are thinking very seriously of having a Research Committee—just like the Physical Research Committee, the Chemical Research Committee, the Biological Research Committee—for science and technology inputs for rural development which will be funded in the various university departments. We are also thinking of industrial problems, particularly those in the small and medium sectors. There are many problems which are common, and we are in the process of analysing these common problems, translating them, synthesizing them, into a number of research problems, and then we are sponsoring them in the university system rather than taking them up in CSIR. Then there are major programmes that have come up. We no longer think in terms of small programmes. We go straight to a large programme if it is effective. Take for instance the water detection programme. We have seen the ground-based resistivity meter system improves the efficiency from 40% to 90%. So, it will be an effective technology whether it is a standard, conventional or high technology. Then there are several major facilities

which are under construction like the Mesospheric, Stratospheric Tropospheric Radar near Tirupati or the giant meter-wave radio telescope in Pune or the science satellites that are now being launched in succession. Then again there are new programmes under biotechnology that have come up—embryo transfer or industrial aspects of biotechnology, new types of drugs and pharmaceuticals, ocean development programme including instrumentation of a special variety. The Antarctic programme—one of the few programmes of adventure for the young scientific community—is expanding and we would like to have a wider variety for participation in this. So there are considerable opportunities in the scientific world. The university communities, and the Science College with all its tradition, can very well participate in a major way and we in CSIR would like to help in whatever form we can in that.

Thank you again for calling me here. I am grateful to you for having asked me to come to the University on this very special occasion.

Thank you.

Presidential Address

B. Raychaudhuri

RESPECTED Mr. Chaudhuri, Dr. Mitra, respected Pro-Vice-Chancellors, respected Alumni, and members of the faculties, dear students and other members of the University community, ladies and gentlemen :

I consider myself fortunate to have the privilege of presiding over this inaugural function of the Platinum Jubilee Celebration of the great Science College of the University of Calcutta. It is a fortunate coincidence on my part that the Platinum Jubilee of the Science College has fallen within my tenure as the Vice-Chancellor. At the outset, I cannot but pay homage to Sir Asutosh Mookerjee while celebrating this auspicious Platinum Jubilee. It is Sir Asutosh Mookerjee's heroic effort which converted this University from just an examining centre to a centre of advanced learning in the truest sense of the term. He made this University the seat of learning and research but Sir Asutosh Mookerjee's dream would not have been translated into reality without the generous contributions of two distinguished personalities, Sir Taraknath Palit and Sir Rashbehari Ghose. They gave away all their life-savings to build up this great Science College. The feudal house of Khaira also contributed to this fund. Over and above, Acharya Prafulla Chandra Ray, a teacher of this University, donated his entire salary for supporting the research schemes and research work of this University. Sir Jagadish Chandra Bose who

was neither a student of this College, nor a teacher, also donated his might for carrying out research in the field of science. Dr. Nilratan Dhar, another student of this College contributed his entire life-saving for the continuity of research work of this University. A collective contribution of these great luminaries inspired by the zeal of Sir Asutosh Mookerjee, could make this University independent of the government funds at that time. Therefore, we will be failing in our duties if we do not pay our deep respect and acknowledge our debt to them on this auspicious occasion. Many other educationists who were neither scientists nor teacher of this University also contributed liberally to augment and sustain the activities of the College. If we stretch back to the days of Sir Asutosh Mookerjee's Vice-Chancellorship, we shall find that he was a creative genius and had unconventional but productive style of functioning.

Indeed, his were endeavours for centralization of post-graduate teaching as opposed to the so called autonomous way of functioning which we often hear again and again. His another endeavour was to identify the appropriate persons for the appropriate jobs and a scanning of the list of teachers, research scholars recruited by him for this College will, no doubt, convince us about his wisdom in identifying persons for the appropriate jobs. I often wonder, how as circumstances stand

today, any Vice-Chancellor can afford to take in budding scientists straightaway to the University as Sir Asutosh could do. Sir C. V. Raman, Satyen Bose, Meghnad Saha, N. R. Sen, P. C. Mohanti, and many other senior teachers in colleges in those days were induced by him. His personal and keen interest in researches of young scientists is a legend. It is often told that Sir Asutosh could keep a track on research activities of active researchers and if there was any apparent slackening of efforts in this direction, he did not hesitate to take them to tasks. If he could know that supervisors and persons at the helm of affairs were responsible, he did not spare them too. He would often communicate his displeasure through students even. I cannot say if any Vice-Chancellor these days can make a move in this direction. Perhaps not. One of his ways of encouraging young researchers was to offer examinership at the University to the brilliant persons even at the risk of violating the so-called seniority.

Asutosh's support to start societies such as Calcutta Mathematical Society, Indian Chemical Society, *etc.* within the precincts of the University and his efforts to ensure early publications of research results provided tremendous impetus to what he envisaged for the emancipation of Science College. Even though there was Acharya Prafulla Chandra Ray as the senior scientist, his was a driving force in every sphere of the University Colleges of Science & Technology. Things have certainly changed over the decades, and I am sure, just offering of an examinership or a support in publication of papers is not going to act as adequate incentive for the young scientists because examinership now has almost become a right and Vice-Chancellors are to appease the examiners than the examiners to appease the Vice-Chancellors

to get the appointment. These activities and programmes have, doubtless, shaped this College and enabled it to attain its prestige and reputation that cut across boundaries of states and the country.

The Platinum Jubilee celebration should make us recall how difficult were the initial days. It is however to be appreciated that though teething troubles have disappeared, the problems of newer dimensions and complexions have emerged. The demand for more and better infrastructures continues unabated. Equipments and more equipments often seem to be a concomitant. I have often asked to myself do we labour under a craze? Is some kind of desire to acquire more for its own sake lurking somewhere in our minds? Steps have been taken for centralization of expensive equipments, and their repair under the USIC scheme. Unfortunately, to the best of my knowledge, the scheme is yet to take off in this University. One has to remember that our resources are restricted and, as a matter of fact, I can mention of my predecessors, who while addressing the Diamond Jubilee celebrations, emphasized the importance of optimal utilization of 'constrained' or limited resources. I am sure the scientific community of this University will definitely look into this point and ensure that optimal utilization of the restricted resources is done instead of going for more and more equipments for their own departments. To quote Professor D. S. Kothari's message to the Golden Jubilee of the Science College, "A great Science College today more than ever has to be something like a coupled system of interacting departments and not merely a campus of physically close but mentally and otherwise remote departments of various subjects. A

Science College is much more than the sum of its separate departments."

I think, in this Platinum Jubilee Year, we must give a serious thought to this advice of the doyen of Indian Scientists which he gave fifteen years back but we have paid little heed to his wise counsel. We say science does not have a national boundary, it is international. But at home it often appears that science is encompassed within the walls of the department concerned. Shall it continue like that? Shall science remain within the walls of the departments or of the University campus? Or should scientists also interact with the different departments and other scientific laboratories in the city and the country so that science can be advanced for the good of the humanity—the main purpose of every scientist? Through University Grants Commission's special assistance, I think, more and more departments are being added rather than enlarging the scope of the departments. Even the so-called multi-disciplinary approach has not been able to break through the walls of the departmental concept. As resources are scarce and will continue to be so, it is high time for us to opt for the optimum utilization of resources.

The solution for optimal utilization lies in the multi-disciplinary approach through different programmes, where we can involve a larger number of appropriate scientists irrespective of their specialization or irrespective of their attachment to a particular department. I am happy to note from Dr. Mitra's comments that CSIR is coming in a bigger way to interact with universities and contemplating setting up centres in different places.

Why shall not Calcutta University play a foremost role in having a National Centre?

Why should not people or the scientists all over the country, if not outside the country, come to this university to work on some specified projects? It may not be possible for us to offer adequate personnel or adequate infrastructure for all the branches of science, but we can identify one area of science which is relevant to the need of the country and for which we can at least afford a reasonable amount of technically knowledgeable persons to take the leadership. Even if we cannot offer ourselves in every area, we can at least arrange for a network of infrastructural facilities for setting up such a centre, and we can foster such a centre.

As you all know, the UGC has already proposed to set up under the advanced scheme of research two or three centres of which two centres have already been set up on the initiative of the universities concerned. So to say, they are acting as a foster mother for these centres. Often people wonder why Calcutta University failed to utilize the Cyclotron Centre which is there for so many decades just a little off from the very campus of this University. By this collection of the infrastructural facilities available in the city, and its own resources, and expertise, why will not Calcutta University be able to attain excellence? As Dr. Mitra confirmed, we have intellects, but often one wonders if we are nurturing them properly to have scientists like S. K. Mitra, Meghnad Saha and Satyen Bose, Or, just we go nostalgic that we had those people? What about the continuous processes? Even if we consider the rate of FRS's, I think, the rate has dwindled and after many years, we have been proud to have Dr. A. P. Mitra admitted as a Fellow of the prestigious society and only one Nobel Laureate so far. The list ends there, and in recent years nothing more has been

added. These are matters which I feel one has to consider on this Platinum Jubilee Day.

Of course, the most important thing is the funding of the universities. All said and done, those days are gone when in 1920 before Sir Asutosh died, he declared in the Senate that this University of Calcutta can jolly well do away without this paltry grant of 2.5 lakhs of rupees of Government of India, when they wanted to put some strings on that funding, though the University was in the red and they were having a deficit of 5 lakhs of rupees. I wonder whether I, as the present Vice-Chancellor, can declare that in the Senate. Rather I have to say otherwise. Whatever strings you like to add, add them, but please save us with money, and there the University community will be beaten. There will be no Sir Prafulla Chandra Ray, to declare in the Senate that "I will convert myself into the profession of a beggar and will go from door to door so that the University do not have to accept this humiliating offer from the Government of India. Yes, the attitude of the Government has changed. The then Government's attitude was to restrain education and the present National Government's policy is to expand education. But Government is Government and rules are rules. And whatever the wish of the Government may be, we have to abide by the so-called financial rules. It is often said that an Indian ambassador abroad can sign an agreement worth million of dollars but he cannot order repair of his chair without following the financial rules of the Ministry of Finance, and as a matter of fact that is the situation.

So, where is the way out? Should the days of Sir Rashbehari Ghose or Sir Taraknath Palit come back? I don't think they will, and also unfortunately there is no Sir Asutosh

Mookerjee. Can the vacuum caused due to the absence of these personalities be filled up by the entire university community? If we put their shoulders together, I think we can raise some finances outside the government agencies. Because, whether we call it CSIR, UGC or any such, all are coming out of the Government fund and obviously the Government has other areas of priorities. University funding in particular has to be done by the State Government whether immediately or at a future date, where everything is coming more or less as a matching grant and a maintenance responsibility. We have also to appreciate the difficulties and limitations of accepting money from funding agencies. Often, we make a mistake by equating private resources with privatization of education. This is not so. Just now, we are facing a problem of recruiting Research Scholars and Research Associates as the Finance Ministry has decided, that without GATE or NET, you cannot get it. It is not a decision of any academic body. It is a decision of the Finance Ministry, Government of India. And so if we have to get money from them we have to abide by the rules, and Calcutta University, I am afraid, do not have adequate funds even to provide adequate salary emoluments to their Research Scholars, because all the endowment funds are in a minus balance today, and it is from the Government grant that we have to make it up. I do not think it is a very happy situation for the scientific community. We want to say that there must be academic freedom, scientific freedom, and economic freedom—I am afraid, the same thing applies as in political freedom.

I just shared my thought with you because basically I am not a student of this College. My profession is quite different. Often some-

body calls the men of my profession scientists, and somebody denies them the right of scientists, but this is a personal feeling. I feel, we need to ponder over a restructuring, a reorganization of the functioning of the College and all types of funding other than the traditional funding agencies. This, and this only, can play a role of renaissance, if you can say that

about the Science College. So, let us take a vow today to bring about another renaissance in the Nineties so that by 2000 AD, Science College again can play the premier role in Indian Science scene which it had at the initial stages as was mentioned by Professor Kothari in his message on the occasion of the Golden Jubilee Celebrations of this College.

Vote of Thanks

D K Sinha

RESPECTED Vice-Chancellor, respected Dr. Mitra, Sri Chaudhuri, Hon'ble Minister, Mrs Ray, Professor Poddar, some of the elder scientists, old peers of this College, colleagues and friends :

It is certainly a privilege, certainly a pleasure, to be associated with this function and to offer vote of thanks. As one who has gone out of the portals of this institution, as a student of this University, all of us, at least myself, owe a certain amount of gratitude and debt to this particular College. So, it is an added responsibility on me as well.

We are indeed grateful to Sri Chaudhuri for being able to come over to this particular function and to tell us briefly what he knows about this College and what he wants us to do in the years to come. We are indeed thankful to you for coming to this particular function and I can assure you that we will remember your words of wisdom in the years to come.

We are indeed extremely grateful to Dr. A.P. Mitra. He is one of our doyens in the Indian Science, among the Indian Scientists. He has mentioned about the upsurge in the Thirties, not in a nostalgic way, but in a highly scientific way, and he has told us of the ways the University can function, possibly in the context of the new thinking in R & D investment, and we can, at the university; and he has mentioned rightly, and we are

indeed proud of such statement. Possibly we can take it, we can cash on that, that the quantum of support to the University has dwindled over the years. This might be one of the areas of discussions in the next seminar. But we would certainly look forward to linkages, to exploring various ways of linkages with CSIR and various other funding systems. And in a way possibly, we can echo the voice, echo the sentiment expressed by our Vice-Chancellor, that may be most of the various science organizations of the country, all of which have come into being after the birth of Calcutta University, should see to it that this great University of ours is not denied the particular national facility in the way envisaged by the Vice-Chancellor. Sir, Dr. Mitra, I will request you to use your good office and influence to see that on this particular occasion and may be in the few years to come and you being at the helm of affairs of anything and most of the things to do with science, that this particular national facility comes and comes up in the campus of this University.

We are grateful to Professor Poddar for having let us know the development of this University. It has certainly ceased to be the examining body. It is very much in examination and still continues to be so for the task. But that is not enough, he has reminded us, and we are indeed grateful to him for an Ex-Vice-Chancellor like him having mentioned

that we need to go beyond something more to do, more of research, more of teaching. I am indeed grateful to you for having mentioned this particular need to this gathering.

I must thank our Vice-Chancellor who certainly was not a permanent student of this College. But he has mentioned about a lot of areas. This has become a convention—a conventional way of things—some of them I think to be very irksome. But it is true, he has mentioned of those benefactors. Can we really think in terms of new benefactors without strings and may be in the years to come this will let us think, this will set us thinking whether this hiatus of funds and the programmes and the progress can be bridged up in the years to come.

I am indeed grateful to all of my colleagues, particularly Professor Daw, Professor Mukherjee in the Faculty of Engineering and Technology, Professor S. P. Mukherjee, the Dean of the Faculty of Science, Dr. Banik, the Secretary of the University Colleges of Science & Technology, and all colleagues whom I would like to be excused if I do not know them, all of my colleagues—teaching and non-teaching—everybody. I must pay my thanks also to the Registrar, the erstwhile Secretary of this College who has put in untiring efforts to see that the particular function, this inaugural function at least becomes a success.

I know that they have been working for the last few months. As you know, in the University of Calcutta, not many of us, we do certainly move a bit slowly whatever we do, almost at the last moment, we do not mince our efforts to see that the function becomes a success. We have been able to bring out, to put up some exhibitions, some programme at least to begin with in this inaugural celebration and all the credit must go to our faculty, to our colleagues in the non-teaching cadre and also various other colleagues among the students as well who have also put up a good show in this particular occasion. I must thank all the peers of this University Colleges of Science—particularly, I find in person Professor S. K. Mukherjee, a former Vice-Chancellor, a former student Professor P. K. Bose, Professor M. M. Chakraborty and many others. I am sorry, I would like to be excused if I do not name them. I find the former Secretary of this College of Science, Dr. S. P. Sarkar, my old teacher Professor P. K. Ghose, Dr. B. D. Nag Choudhuri and many others, who have come. We are indeed grateful to all of you Sir, for having been able to come and would like to seek your advice and suggestions once again to see that this College continues to have a distinctive personality and distinctive way of functioning, perhaps, much to the chagrin of many other constituent parts of this University.

Thank you once again.

Frontiers of Science and Technology by 2000 A/D Related to Polymers

D. Banerjee

THE world's economic projection has been reset during the last 3/4 decades with a positive trend of growth for all countries—developed, developing and under-developed—through the advent of polymeric materials—products designated as high polymers. In fact, polymer science and technology has contributed products, *viz.* elastomers—plastics—man-made fibres—with tailor-made designs and structures to suit all walks of life. The understanding of basic science related to physics, applied physics, chemistry, engineering and all other disciplines owe a good deal to the development of polymers. The last decade of the twentieth century can be treated as the decade dedicated to polymers development. The transfer of technology for the said development has also been transmitted most effectively from industrially advanced countries to developing and under-developed countries in a manner that it has also contributed to the economic development of such countries.

However, as Blackett stated: "Science is not a magic wand to wave over a poor country to make it into a rich one." The concept that the world super-market of

technology is full of riches and comforts produced by other people's research efforts and are there merely to be plucked by the developing countries for satisfying their growing hunger is also equally unrealistic. Technological growth to be self-generating and self-propagating, has to be endogenous and must be rooted in the basic scientific intellectual atmosphere and technological skill and industrial organisation of a country.

Inadequacy of knowledge of raw material characteristics, multiplicity of process and machinery, lack of standardisation, ill-digested technology and inability to control operations (which involve intimate knowledge of characteristics of equipment and principles of processes) have led to at least 40% wastage of scarce capital invested, much of which constitutes foreign exchange in developed countries.

BASIC RESEARCH

Fundamental and basic-oriented research is essentially not only for training of scientific intellect and for providing the succession in the scientific field, but also for converting knowledge into techniques, equipment and apparatus for study, measurement, probes and advancement in methodology and techniques of science. While the first may

Based on the talk delivered by the author on the inaugural day of the week-long Platinum Jubilee Celebration of UCSTA.

have to be organized in the Universities or around them, in a country where centres of higher learning have been predominantly teaching-oriented, creation of basic-oriented research centres in the major disciplines of natural science (chemistry, physics, mathematics, biology and earth science) is a separate task and must be organised with the purpose it has, *viz.* for conversion of knowledge into techniques, apparatus and equipment, research and innovation in the techniques of measurement of properties of matter, their transformation into tools for studying their behaviour under various conditions. Modern scientific, technological and industrial research have to be backed by an array of scientific apparatus and equipment, as well as an efficient and organised information service covering many disciplines and techniques, each of which tends to become highly specialized.

APPLIED RESEARCH

The output of fundamental and basic oriented research are the inputs for applied research. The outputs of applied research by themselves cannot, however, lead to development. Applied research has a dual function, operating simultaneously in two directions :

- (i) acquiring knowledge of behaviour of raw material resources, and
- (ii) developing the tools and exploring the methodology for utilising and conserving them.

These are long-term tasks, which have to be organised and paid for. They constitute the basic infrastructure for technological development. Applied research involves both science and technology. It employs science and develops technology to a point where a concept is formulated for development of either an equipment or a process for production, or a product by synthesis or mutation.

INVENTION AND INNOVATIONS

There is, however, a major difference between invention and innovation. "Results of research are inventions, while innovation is setting into operation the complicated and complex process of actual utilisation of the invention". Transformation, therefore, involves setting up of a stable research and development network continuously operating, inventing and innovating, coordinated and guided by basic objectives and directives, but largely free to choose the methods of execution.

"In a developed country, the higher the economic development, the greater is the percentage of gross national product invested in research". But, in developing countries, research has to proceed simultaneously with generation of economic potential, for it takes considerable time to translate it into profitable results. In developing or under-developed countries, therefore, applied research and development must be organized simultaneously and coordinated for a basic objective. Organisations have to be conveyed for this purpose.

Insofar as India is concerned, the application of polymers, particularly elastomers, plastics and thermoplastics have steadily grown in agriculture, industry, mining, surface transport, air transport and health services and many other services conducive to national development. To talk about elastomers, India is fortunate of having natural rubber as a primary plantation in the South which has sustained the growth of the Indian rubber industry, having achieved a capacity exceeding 300,000 tonnes per annum, during the last 4/5 decades. It is projected that the natural rubber production

may go upto 450,000/500,000 tonnes per annum by 2000 A/D.

However, considering the growth of both automotive tyre sector and the non-tyre sector, viz. industrial rubber products, medical rubber goods, industrial hoses, power transmission belting, conveyor belting *etc.*, it is projected that India's requirement is likely to be around 1 million tonnes per annum of new rubbers by 2000 A/D. Obviously, the gap has to be met through introduction of various types of synthetic rubbers.

Currently, styrene butadiene rubber is produced in the country to the extent of around 35,000 tonnes per annum. In addition, polybutadiene rubber is also being produced at the rate of 20,000 tonnes per annum.

The above production is quite inadequate to meet even the requirement of current production of the industry. As such, plan of production for future development has already been taken towards the following :

1. Styrene Butadiene rubber-
additional 100,000 tonnes per annum
2. Butyl rubber 35,000 tonnes per annum
3. EPDM 30,000 tonnes per annum.

Production of above synthetic rubbers is possible in the light of development of Petro-complex industries in India. The pattern of usage in highly advanced countries is approximately in 80 : 20 ratio between synthetic and natural rubber whereas in India the position is just the opposite, i.e. of the total rubber consumption 20% represents synthetic rubber and 80% natural rubber. By 2000 A/D it is expected that synthetic rubbers will constitute around 35/40% of the total new rubber consumption. In any case, speciality rubbers such as polychloroprene, polyisoprene rubber, chlorosulphonated polyethylene rubber, fluo-

rocarbon rubbers, hypolan *etc.* will continue to be imported for specialised applications.

With the scenario of polymers as given above upto 2000 A/D, various other additives, viz. rubber chemicals, carbon black, man-made fibres *etc.* are also being produced in adequate quantities to satisfy both national and international standards. The growth of the above specific materials has also been duly projected and steps have been taken by manufacturers and allied agencies to maintain steady supplies. However, there is scope for import of specialised chemicals, fibres *etc.* to meet specific needs of product design and structures.

Insofar as automobile tyre industry is concerned, the cross ply tyres (bias/diagonal tyres) have dominated the Indian market. Insofar as International market is concerned, tyres of radial construction have practically wiped out the usage of bias tyres, considering three primary features of radial tyres, viz.

1. high mileage (almost double the mileage of cross ply tyres)
2. retreaded radial tyres also give the same mileage
3. fuel saving of around 7-8%.

Radial tyre production in India, both passenger cars, light commercial vehicles and also for giant truck tyres in all steel construction, have proved to be satisfactory in certain areas of application.

Thus the science and technology of the decade is being geared towards radials by the tyre industry to the extent that 50% of passenger car tyres, semi-commercial vehicles, are likely to be manufactured in radial construction, whereas giant truck and bus tyres in radial tyres is likely to constitute 25-30% ; if not more.

The above represents the unique trend of development towards reaching the frontiers of elastomer science and technology by 2000 A/D.

Insofar as non-tyre sector is concerned, already steel cord as reinforcing material has been successfully introduced in products, particularly conveyor belts and industrial hoses. Here again, in place of conventional man-made fibres, steel cord has found to be invaluable. The life-expectency of such product will be around 9 to 10 years as against the conventional product with man-made fibres life expectancy of 5 to 6 years.

The most encouraging trend in the elastomer field, as stated above, is towards high performance, heavy duty application, matching with international standard in quality and performance, ensuring safety and reliance and cost effectiveness.

Insofar as consumer products are concerned, *viz.* footwear, medical goods *etc.* high technology is also being applied with identification of proper materials to match the international standards.

The elastomers industry as a whole including application of thermo-plastic elastomers has established its impact in all areas of economic development, *viz.* surface transport, air transport, engineering—both mechanical and chemicals, mining industries and oceanic development. This is the age of polymers and the development is unlimited if the basic and applied research through R & D efforts are carried out intensively keeping an eye towards high quality performance and international standards.

Insofar as plastics are concerned, a massive blue-print has been drawn up in the National Plan covering all types of hoses for agriculture, industry, mining, oil exploration, packaging and particularly engineering application and transport vehicles and aircrafts.

All plans for transfer of technology are set up including production of basic plastic materials to the extent of about 700,000/800,000 tonnes by 2000 A/D to meet the national requirement.

Another area that is also being conceived as a potential growth during the present decade is the field of engineering towards development of specialized machinery and equipments including process and testing equipments with highly sophisticated control systems to match the scale of production as envisaged. Engineering skill through manufacture of highly sophisticated moulds, dies, tools for specific applications will also prove to be an invaluable contribution for development of polymers comprising both elastomers, thermoplastic elastomers and plastics. Needless to say that man-made fibres, *viz.* nylon, polyester, carbon fibres *etc.* will also encompass large areas of application in production.

The above is the glimpse of the frontiers of science and technology of polymers towards achievement of the national goal.

In conclusion, the frontiers of science and technology of polymers in the context of rapid development and applications in various fields will reach dominating heights of success keeping one eye on development of science and technology and the other towards social development and employment.

SECTION : 3

Down The Memory Lane



Applied Science and the Faculty of Technology in the University of Calcutta

G. N. Bhattacharya

THE lesson that the political leaders of our country learnt soon after the failure of 'Boycott of Foreign Goods' programme during the days of 'Swadeshi Movement' at the beginning of this century, prompted them to establish some indigenous industries to supply essential goods to our poverty stricken people. A group of patriotic educationists, like Sir Asutosh Mookerjee and Pandit Madan Mohan Malaviya, felt however that this enterprise on the part of our industrialists was also bound to fail sooner or later, unless arrangements were made to impart sufficient technical education to our people to run these industries. The solution of this problem was not easy, since the spread of technical education in this country was against the policy of the then alien Indian Government. I have described elsewhere (Diamond Jubilee Souvenir, Applied Physics Dept., 1985-86) how Sir Asutosh tried to impart higher engineering and technological education through the University of Calcutta under the guise of Applied Science. But he was only partly successful in this attempt, since the Government later saw through this game and refused to grant any money to the University for this project, despite early assurances, on the usual pretext of financial stringency. The first World-War also broke out near about this time and the Govt. stopped all extra

expenditure on the pretext of diverting it to meet urgent war effort. In the mean time Sir Asutosh had collected a princely donation of several lakhs of rupees from Sir Rashbehari Ghose, the renowned lawyer of Calcutta, for the creation of two endowment chairs in the University in Applied Science—one in Physics and the other in Chemistry. When his ambitious scheme of building a grand University College of Science & Technology was rejected by the Govt. only the present Science College building — which was initially meant for Chemistry and built on a plot of land also donated by Sir Rashbehari Ghose—was nearing completion.

As soon as the War ended Dr. P. N. Ghosh and Dr. H. K. Sen were selected for the two chairs in Applied Science and sent abroad for practical training and experience in post-war higher technological education in Europe. On their return after about 3 years both of them faced tremendous difficulties for want of funds. Sir Asutosh's sudden death at this time cast a gloom on the situation. But with the active co-operation on their colleagues in Science College as well as of many others in reputed industrial concerns in and around Calcutta, the two young professors ventured to make a small beginning by admitting only six students in each of

these two new departments. With the passing of years the situation gradually became somewhat easy due to the University transferring more and more funds each year for men, machines and materials for these two Departments. A substantial amount was secured by Dr. Shyamaprasad Mookerjee from a Trust when he became Vice-Chancellor of the University for the communication engineering section of the Applied Physics Department.

About this time, when some students from the Applied Physics Dept. wanted to sit for the Central Govt. Engineering Services Examination, Prof. P. N. Ghosh wrote to the Central Government for permission. Soon a delegation from the Institution of Engineers (India) visited his Department for this purpose. After speaking very highly about the syllabus, the delegation advised him to spread it over 3 years, since according to their Regulations the Institution could not recognize a 2-year degree. But there were genuine difficulties on the part of the University to do it, since the Dept. was then in the Science Faculty and M.Sc. degree in all other subjects was of 2 years duration. The Second World War however broke out about this time, and the demand for these students increased immediately—so much so that within a short time they were booked in advance by reputed industrial concerns even before they passed out. Nobody cared about recognition then.

During this War, India passed through a great political turmoil. National Congress leaders like Mahatma Gandhi and Jawahar Lal Nehru were thrown to prison for their non-cooperation with War efforts and subsequent 'Quit India Movement'. At the end of this War, however, an Interim National Govt. was formed at the centre with Lord Mountbatten at its head and Pandit Nehru as his Prime

Minister. This Government put great importance on engineering and technological education and immediately formed a high-power committee to decide on the steps to be taken for its implementation. This committee decided after a short visit to U.K. and U.S.A., that four Institutes on the pattern of M.I.T. in U.S.A. should be built in this country. But since it would take some time to build up these institutes, the Committee decided to give in the mean time liberal grants to a few existing Institutions, where such technological education was then imparted. Applied Science Departments of Calcutta University were selected, among others, for this purpose by the Central Govt. with certain changes in their structure. Sir J. C. Ghosh, who was then Director-General of Supplies and Disposals at Delhi and formerly Director, Indian Institute of Science, Bangalore, led a small commission for distribution of grants by the Central Govt. At Calcutta this Commission recommended that a separate Technology Faculty should be created at the University and a separate college of Technology established, comprising the two existing Depts. of Applied Physics and Applied Chemistry and a new Dept. of Radio Physics and Electronics by combining the Wireless Laboratory of Physics Dept. and the Communication Engineering Section of the Applied Physics Dept. The degree awarded by the University to the students coming out of this Faculty after completing a 3 year course was to be M.Sc. (Tech.). Other departments could also be added to this Faculty as and when necessary. The entire fund required for this development would be provided by the Central Govt. in accordance with a detailed plan to be submitted by the University later.

But unfortunately, for various reasons, the University could not fully utilize this

golden opportunity, although it accepted the recommendations of the Commission. There were genuine difficulties on the part of Calcutta University to handle such a big plan within such a short time. Dr. P. N. Ghosh had retired from the University just before independence and he passed away in the same year. Dr. H. K. Sen, who left the University earlier, was no more. When Prof. Mahanti, who occupied Prof. P. N. Ghosh's chair then, went to Sir J. C. Ghosh to submit the first expansion plan for his department involving some 3 lakh rupees, Dr. Ghosh told him with a smile that he could have easily sanctioned a plan of 2/3 crore of rupees for this new Technology Faculty, if only proper schemes could be submitted. However, the admission of the first batch of M.Sc.(Tech.) students in this new Faculty of Technology took place in 1951, after a hurried preparation for the creation of the new Department of Radio Physics & Electronics under Prof. S. K. Mitra.

Within a short time all the three departments under the new Faculty faced difficulties for want of funds. About this time in 1954, Sir J. C. Ghosh became the Vice-Chancellor of Calcutta University at the request of D. B. C. Roy, then Chief Minister of West Bengal. Encouraged by his dynamic presence, the three Technology Departments wanted to submit a much bigger scheme for the second 5-year plan. In the mean time, I had joined Applied Physics Dept. after resigning from a Central Government post. I knew Dr. Ghosh and Dr. Bhatnagar quite well during my previous assignment. One day the Vice-Chancellor rang me up to say that Dr. Bhatnagar had come to Calcutta and

was staying at Great Eastern Hotel. He advised me to take Prof. Mahanti and Dr. D. Chakraborty, then Secretary of the University Colleges of Science and Technology, with me and see Dr. Bhatnagar and plead for an expanded second 5-year plan for Technology Departments. When we met Dr. Bhatnagar and told him the purpose of our visit, Bhatnagar told us, "I am afraid you have missed the bus. The Government of India in 1955 is not in the same position as it was in 1950. The financial position of the Central Government in this Department has completely changed during this period. After building the first IIT at Kharagpur by spending over 4 crore rupees, we find it is not yet complete—and we are committed to build 3 more such Institutes, besides our financial commitments already made to other Institutions." Even then we frankly discussed our problems there regarding staff, space and equipment and he assured us help within his limited means. When we reported our discussion to the Vice-Chancellor, he only remarked: "Opportunities rarely come twice." Sir J. C. Ghosh left the University soon after to become a Member of the Planning Commission at Delhi. But even during this financial stringency, the Applied Physics Department obtained a grant of about 25 lakh of rupees for this second plan. Similar grants were also received by the other two departments of the Technology Faculty for their second plan.

This is briefly the story of Applied Science of Sir Asutosh Mookherjee blossoming into the Technology Faculty of Calcutta University to-day.

Poor Facilities : Rich Environment

R. N. Chakravarti

IN 1937, when I joined as a 5th year student in Pure Chemistry of Calcutta University, students with B.Sc. Hons. were permitted to carry out research work in the 6th Year in lieu of 75% marks of Practical. Thus using M.Sc. students, Dr. J. C. Bardhan could carry out such important work as syntheses of homoapofenchocamphoric acid, isofenchocamphoric acid, *cis*- and *trans*-(dl)-isofenchocamphoric acid, dl- β -fenchocamphorone, dl-isofenchone, dl-angustinone, *etc.* I heard a lot of remarks against Dr. Bardhan's nature and behaviour, and even my elder brother, then a medical student, spoke about the same so that I might not work under him, though by that time he established himself as one of the foremost amongst chemists of the country through his synthesis of Balbiano's acid and the first partial synthesis of estrone methyl ether in London and the 'Bardhan-Sengupta Synthesis of Phenanthrene' at Calcutta. Even the results of his earlier work on cyanoacetamide condensation for D.Sc. of Calcutta were utilized by Harris, Stiller and Folkers in their synthesis of pyridoxine (Vitamin B₆). I understood, he was not liked by Sir P. C. Ray and naturally by a host of others. In fact, he wept when he stood second in M.Sc. without a First Class, and was upset when he could not get a place to work in Ray's laboratory. However, this was highly compensated when, one day while he was working with full attention, to his utter surprise he suddenly found

Sir Asutosh Mookerjee, the builder of the University College of Science and Technology, at his back and patting him in appreciation of the excellent reports on his D.Sc. thesis received from well known foreign experts.

Unhesitatingly I decided to have my M.Sc. thesis under him and for this I had to start work from the very first day of the summer vacation, between 5th Year and 6th Year, *i.e.* from Sunday, 1st May, 1938. He became a lecturer about this time—in such matters he had all support from Dr. Shyamaprasad Mookerjee, who like his father, strongly supported the real deserving cases even against heavy odds. The most serious teacher in the theoretical class was Dr. Bardhan and in the practical class—Dr. P. B. Sarkar, who was also not much liked by Sir P. C. Ray and possibly this led to the friendship between the two. Dr. Sarkar was much more interested in demonstrating how to carry out a complex analysis than to give a lecture on that. On several occasions, Dr. Sarkar came to our laboratory with his apparatus, *etc.* to help me.

For about 15 years, Prof. H. K. Sen built up the Applied Chemistry Department. In front of the newly built one storied building of the Department there was a big tin shed and a tall chimney. There were arrangements for training in soap making and thus a large

number of soap factories started in and around Calcutta impeding import of foreign soap. As a pioneer research worker in industrial chemistry of the country, he was deeply engaged in the fuel problem, and not merely thought about direct utilization of water hyacinth, a pest of these days, as fuel and recovery of potash salts from ash, but also for production of power alcohol by its fermentation as also of the wood of *Excoecaria agallocha*, low temperature carbonization of coal, etc. In 1936-37, he joined as Director of Indian Lac Research Institute, Ranchi. By his departure, the University lost a very prospective teacher devoted to development of an efficient school of industrial chemistry. Though he diverted seriously his attention to development of the lac industry, he became rather isolated and missed his cherished contact with the newer batches of students and inspiring them in industrial research for development of chemical industry in India. It seems, he also faced the same type of environmental problems as faced by Dr. Bardhan and Dr. Sarkar in spite of his more fortified position while in the University. Whenever he used to come to Calcutta, he searched for the best amongst the students for engaging in his Institute and providing him with all possible facilities even for independent work. Thus he brought up Dr. S. R. Palit at Ranchi. It was rather unfortunate that after his departure gradually his name here got more or less wiped out, except for the H. K. Sen Memorial Medal and Lecture of the Institution of Chemists (India), while the newer batches of students appeared to be ignorant about him. After the death of Prof. B. C. Guha, his successor, and separation of Biochemistry as an independent Department of the University and its shifting to a separate building, however, a statue of Prof.

Sen has been prominently placed in the Applied Chemistry Department.

During the heavy monsoon of 1939, I had my *viva voce* examination for M.Sc. thesis. Prof. Sen came from Ranchi and Prof. S. S. Guha Sarkar from Dacca, while Prof. Satyen Bose, also from Dacca, was present just in view of his interest in chemistry and performance at viva of a good scholar. Broad minded as he was, Prof. Sen simply asked me to describe what I did. With the help of the black-board, I spoke at length about all the various aspects of my work. After having clarifications from me on a few points, he left the place to meet some of his old friends in other laboratories, when Prof. Guha Sarkar brought out from his pocket a long list of questions drawn up like the marketing list of a veteran house-wife. As my answers were rather elaborate taking care of associated matters, he had often to skip over several items of his list as already answered. After about two hours, Prof. Sen came back and remarked, "Sarvani, why are you still carrying on—let him go." But just when I reached the door, he suddenly called me and asked, "Just tell me what happens when you add sodium hydroxide solution to phenolphthalein solution." Using the earlier technique of blowing up a small question into a big one, on the black-board I showed the structures of colourless phenolphthalein, its pink monosodium salt and its colourless trisodium salt and remarked that with a little alkali the colour was pink but with excess of alkali it was colourless again. But Prof. Guha Sarkar was active again, as he asked, "Were you coming here during the last few days to hear about trends of *viva voce* questions?" Here also I made a long answer, "In view of the heavy rains my parents kept me indoors.

During examinations throughout my life they took all care for my health. Besides this, while preparing for M.Sc, theoretical even, I never went round the students for knowing the trends, but the students themselves, including those who were being privately coached by University teachers, used to come to me for having proper answers to some of the so-called expected questions and thus I could gather such trends at home though I never cared about those as a voracious reader. After each University examination I relax holidaying outside Calcutta and this time, in a few days, I shall leave for a month's stay at Deoghar with my mother."

The very next day, I had a special message to see Prof. P. C. Mitter. From him I understood that I got full marks in *viva voce* and that Prof. Sen wanted to have me at LRI, Ranchi. I declined the offer as I was determined to continue to work in Dr. Bardhan's laboratory. I found Prof. Mitter was keen to see me sever my connection with Dr. Bardhan as he insisted that I should not have a rash decision without consulting my parents. While I was at Deoghar, the second Great War started on 1st September, 1939. Sometime later I returned to Calcutta and continued my work in Dr. Bardhan's laboratory. In fact, the laboratory was put in my care so that he could concentrate in more pressing matters.

The University research grant was nominal, but earlier during his long period as a Research Fellow he could accumulate a good stock of apparatus and chemicals on the basis of his long term plan of work. A life-long bachelor, he led a very simple and thrifty life but spent a lot of his savings for his researches, maintaining a Laboratory Assistant and an M.Sc.

Research Assistant. Things became considerably better when he became Honorary Advisor to a rising pharmaceutical firm and had substantial annual research grant from them. I used to maintain the account in respect of this amount. We paid considerable attention to accumulation of our anticipated requirements of chemicals and apparatus in view of expected scarcity with progress of the War. Dr. Bardhan used to get very much annoyed in cases of breakage and wastage. We never felt any serious shortage but for simple things like glass rods and tubes, rubber tubes, corks, etc. we had to develop the habit of beg, borrow or steal from other laboratories.

We used to remain standing all day and worked upto late hours in the laboratory and our daily output was high. Dr. Bardhan himself was a very hard worker, and he was pioneer here in syntheses of liquid organic compounds. We were accustomed to preparation of highly poisonous and dangerous chemicals and the training available was excellent. As help from the microanalyst of the Department was not available we had to carry out macroanalysis for C, H, etc. in the Combustion Room, with a number of combustion furnaces, a covered space for bomb furnaces and an enclosure for ozonolysis work. With only one door open in that big room and several furnaces working, it was a hell-like place in hot and humid weather, but we were mostly happy with the results. On one occasion, after satisfactory results of analysis were obtained by an M.Sc. thesis student, it was found that he mistook the product to be an ethyl ester and forgot that it was a methyl ester. He immediately brought from the Combustion Room a slip of paper containing his original actual data and the correct results

for C, H % which he wrongly thought to be wrong on the basis of his wrong idea that his product was an ethyl ester though it was actually a methyl ester. Thus he learnt that if the compound was pure and the method was followed strictly it was never necessary to back-calculate.

We were indebted to Prof. P. B. Sen of Physiology Department for using his vacuum pump as our own in our laboratory all the time and also using his refrigerator. When the electric line of our very small balance room in ground floor stair-case landing remained faulty for a long period we had to get used to weighing in flickering candle light. Later I could get metallic sodium from below the wooden block for the switch, which was coming out, and when it was thrown in the outside open drain it caught fire and exploded. Obviously, it was formed by the action of leaking electricity on sodium hydroxide of cement. The line had to be disconnected. As the intensity of the War increased, after dark we were not permitted to use light and had to carry out our work without use of electricity in the light of luminous Bunsen flame. One day, while working alone like this, using a bored cork, instead of a good cork, I poured bromine on my hand. Of course, immediately I washed the hand in running water under the tap and then in dilute ammonia, but it took several days to recover.

One morning I was helping R. Swaminathan, a very bright student with First Class First in B.Sc. Chemistry Hons. (later also First Class First in M.Sc.), in his work. He was a very enthusiastic but clumsy worker. He smashed a Winchester full of conc. sulphuric acid against the table and splashed a lot of the acid on to me. After taking some first-aid myself, as there was none else in

our laboratory at that time, and borrowing a *dhoti* from one residing nearby, I returned home and was under treatment for over a week. He also broke one evening the lid of the largest vacuum desiccator of Science College, originally belonging to Sir P. C. Ray, brought to our laboratory when Rashbehari Chatterjee, an old bachelor, started working in our laboratory. I was very worried how to tell Dr. Bardhan the next morning, but was much relieved ultimately to know that Swaminathan met Dr. Bardhan the same night and somehow managed the matter with him. Chatterjee was out of touch with chemistry for a long time and was brought to our laboratory by Dr. Bardhan perhaps for his apparatus and chemicals. As a worker he was not only clumsy but also very timid. One day, while Dr. Bardhan was helping him the reaction mixture caught fire. As Dr. Bardhan was holding the flask with his hand I ran with an asbestos board and stopped the fire smoothly while Chatterjee moved backwards very fast up to the door and tore off his fashionable saffron coloured *khadi* apron with binders at back.

One night, while I was busy labelling the different fractions after a vacuum distillation, I was asked by one to take him to Dr. Bardhan's residence. As I was keen to finish my work and then go, he said he was in a hurry and that he would drop me on his way back. Dr. Bardhan was at that time in mourning for his father's death. When we reached the place I understood that I should call Dr. Bardhan to come down from his second floor flat as he was unwilling to go upstairs. When I wanted to know his name I found that he was Prof. M. N. Saha. This was thus the first time that I met him although he was in the Physics Department for over three years by that time. On another occa-

sion, a group of students of Baroda University came to our laboratory. After I showed them our laboratory they wanted me to take them to Prof. Saha. At that time I found him working in the Workshop near the Applied Chemistry building. I met my class-mate Dhiren Kundu and told him about my errand while the students were kept waiting outside. He told me to tell Prof. Saha about it myself and so I requested Prof. Saha to meet the students but he declined. I had nothing but to carry the unpleasant message to them. About this time he was working pretty hard for having the Institute of Nuclear Physics and collecting funds from outside. I saw him working under the sun and rains for growth of the building brick by brick. So also the new colloid laboratory annexe of the main U-shaped building of Science College came up using funds from outside sources due to the untiring efforts of Prof. J. N. Mukherjee.

Once Prof. Mukherjee started weekly Colloquium. Prior to my turn, Dr. Bardhan cautioned me not to give any hint about the work I was doing. Today, after having suffered a lot from unhindered "daylight robbery" of even published results, as seriously reported against by no less a person than Sir Robert Robinson, Nobel Laureate and a President of the Royal Society as also by the authorities of a well known foreign journal, I duly appreciate the advice of Dr. Bardhan. In view of his advice, I spoke on "Chemistry of Antileprotic Cyclopentenyl Fatty Acids of the Chaulmoogric and Hydno-carpic Acid Group" illustrated not only with pictures, photographs and projection slides but also the different plant specimens, fruits, seeds, oils, etc. The subject was quite new to me and I had to study thoroughly and in this respect I was extremely indebted to Prof.

J. Lowe of the Calcutta School of Tropical Medicine. He gave me for reading his personal books and journals on the subject and all the required materials.

Grievances I had, for instance an award was resolved in my favour by the Syndicate—I had congratulations from many, and when I met Shri Satishchandra Ghosh, Inspector of Colleges and told him about attempts for depriving me of the award being made by a very influential person to please a young kid, he simply laughed aloud and asserted that the next meeting of the Syndicate was just for confirmation of the proceedings of the previous meeting—and yet it happened on the basis of a new letter extracted from one selector from North India and all those to whom I predicted about the mischievous move became embarrassed so much so that I had access to the papers involved. This particular scientist (an aspirant for F.R.S.) visited Oxford in 1946. I introduced him to Sir Robert Robinson the then President of the Royal Society, and showed him round. While he was leaving, I told him about his misdeed saying that one of the selectors from South India remarked that my work was by far the best of the lot and that as it was highly theoretical it might not be appreciated appropriately by one who was not working in that area and I added that as he never worked on theoretical aspects he could not appreciate my work. He found me as the most popular figure in Robinson's group, felt embarrassed at my frank statement and acknowledged that he wrote the addendum under the influence, as he named, of an F.R.S. of Calcutta University. At this stage of my life it is quite a minor matter but I am recording this as a kind of solace to other growing kids falling a prey to nepotism in the Calcutta University. For instance some years

back a student, who stood first at the M.D. Examination and was congratulated by the Examiners, ultimately found his name in the third position and the name of a girl student, a near relation of a very influential physician, in the first position. In this case, I reacted very sharply with the Vice-Chancellor and ultimately the position was corrected when the Examiners confirmed it before the Vice-Chancellor.

Finally I must acknowledge that in spite of these petty bickerings, I earned a huge lot while in Dr. Bardhan's laboratory and utilized the acquired knowledge in the laboratories abroad and in my later life. The place was like a temple to me—real holidays only 2 or 3 days in the year as I worked very hard on Sundays also coming at 4 a.m., by climbing over the railings in front of the building, while the gates were closed and the durwan was sleeping, and leaving by 1 p.m. I must acknowledge my indebtedness to Shyamlal, the senior bearer of the General Laboratory, for simple laboratory techniques. But above

all I must name Dr. Shyamaprasad Mookerjee who directly helped me in the later stages against odds. In fact, for the particular award mentioned above while I was making arrangements to meet him Dr. Bardhan came to know about it and earnestly requested me to refrain from doing so as in that case it might become difficult for him to become a Professor and so I had to give up my proposed attempt on that occasion and left the University to accept an outside job as Chief Chemist of a rising firm of those days and then left for Oxford. Whenever I look backwards at the conditions of the Science College, I remember the great part played at the earlier stages by Sir Asutosh Mookerjee and during my time by Dr. Shyamaprasad Mookerjee, who were sincerely keen to hear the genuine grievances of good scholars and this position removed any ground for having any feeling of frustration and I wish very much if such a position can be revived in the Calcutta University. There should be a limit to ruling under the canopy of authority so that nepotism may not thrive and real good scholars may not feel frustrated.

Science College — Past and present

Asima Chatterjee

THE University College of Science, the brain child of Sir Asutosh Mookerjee, was born on 27th March, 1914, just four days before the fourth term of his Vice-Chancellorship was due to expire. The beginnings of the University College of Science could be traced to 1906 when the Government of India promulgated on 11th August, 1906, a set of regulations on the recommendations of a committee under the Chairmanship of Sri Asutosh Mookerjee. It was decided that "the University shall provide for Post-Graduate teaching, study and research in the Faculties of Arts and Science". Thus a nucleus of science for both teaching and research was created in the University of Calcutta. The development of the science departments was greatly facilitated by the magnificent donations received from three generous donors, Sir Taraknath Palit (1912), Sir Rashbehari Ghose (1913) and Kumar Guruprasad Singh of Khaira (1919). The first professorship created was the Hardinge Chair of Higher Mathematics out of Government grant. The Palit funds provided for creation of two professorships, one in chemistry and the other in physics.

The main building of the University College of Science at 92, Acharya Prafulla Chandra Road, is still known as Taraknath Palit Building as it was constructed on the land donated by Sir Taraknath. The palatial

residential house of Sir Taraknath Palit at 35, Ballygunge Circular Road, housed the other departments of science till a nine-storied building out of UGC grants was raised on the land to provide accommodation for several other departments.

The Ghose Endowment stipulated for the funding of six professorships in Pure and Applied Chemistry, Pure and Applied Physics, Applied Mathematics and Botany. The Palit and Ghose endowments allotted sufficient funds for the provision of scholars and assistants. Later, University professorships in Physics, Chemistry and Agriculture were created out of the endowments of Kumar Guruprasad Singh of Khaira. The extent to which the objectives of the donation and the wishes of the benefactors were fulfilled could clearly be judged by the publications emanating from this "Centre of Learning" in different international journals and also from the activities and achievements of the post-graduate students who are working in schools, colleges, Universities, research institutes and industries in India and abroad.

The University came to be recognized as one of international fame. This was borne out clearly by the award of fellowships of the Royal Society to Professors Chandrasekhar Venkat Raman, Meghnad Saha, Satyendranath Bose, Prasanta Chandra Mahalanobis and Sisir Kumar Mitra. Professor C. V.

Raman was also awarded the highest international distinction, the Nobel Prize, for which this country can take a special pride. Such outstanding achievements not only added to the glory of this University but also to Indian science. Professor Satyendranath Bose later became National Professor. During that time, the Department of Chemistry, guided by Acharya P. C. Ray, produced a large number of scientific stalwarts. Gradually, in keeping with its ideal of advancement of learning, the University of Calcutta extended its sphere of activities and several new faculties and institutes were added, notable among them being the Institute of Nuclear Physics in 1945, later known as the Saha Institute of Nuclear Physics, and the Department of Radio Physics and Electronics in 1946. During the post-independence period many of the university teachers in science and technology received the highest scientific recognition in our country, viz. the Sir Shanti Swarup Bhatnagar Award by the Council of Scientific and Industrial Research, Government of India. Many departments received appreciation for their outstanding research activities in the form of recognition by the University Grants Commission as Centres of Advanced Studies.

I have had the privilege of holding the chair of Kumar Guruprasad Singh Khaira (Khaira Chair) in Chemistry for more than two decades. Although I retired in September 1982, I am still acting as the Programme-Coordinator of the Centre of Advanced Studies on Natural Products, created by the University Grants Commission under my leadership in 1973, in the Department of Pure Chemistry.

My active association with the University College of Science is for more than five decades. During these years this science

Centre has undergone a remarkable change. Looking back, I cannot but admit that I miss the pulsating, vibrating and electrifying atmosphere which existed till 1965. Since my school days, I had a great fascination for studying science and cherished a desire to study in the Science College. For the resurgence of advanced study and research in science in our country we owe much to Science College, perhaps more than to any other institution in India. I had the opportunity to study in this Science Centre in July, 1936. It was a memorable event in my life when I first joined the first year M.Sc. Class in pure Chemistry. The lecture theatre is on the first floor of the southern part of the building (known as Taraknath Palit Building). While entering the lecture theatre I could see two senior teachers seriously discussing some problems. Suddenly one of them asked me, a tall and thin person with a beard, whether I was a student in the department? His next question was "Will you be able to work hard? Have you any interest in research?" I said humbly, "Yes sir, I am a student in this department." Later I learnt that this tall and thin person with sparkling eyes was none other than Acharya Prafulla Chandra Ray. He was then the Emeritus Professor of the University. The other person was Professor Jnanendra Nath Mukherjee, the renowned physical chemist. While looking at the laboratories I felt a thrilling sensation and the urge to carry out research. Here I had seen the teachers doing bench work and also helping their research scholars. This is perhaps unthinkable to the present generation. In the second year we had to select our special paper and work for a project on which a thesis had to be submitted. While working for the project I used to come at eight in the morning. My revered teacher, Professor Profulla Kumar Bose, then lecturer, used to

come also. Our research laboratory was on the first floor. After attending theoretical classes we continued our research till late in the evening, sometimes till eleven at night. We received inspiration to work from our teachers who had been working in the laboratory and in the library from morning to evening. They had left for us a legacy of infinite capacity for hard work and indomitable zeal, and infused in us the spirit to work with devotion and love. Unfortunately, this dynamism is slowly ebbing.

In our times there was no attendant to cleanse the apparatus. Everyday, before starting our work we cleaned the working benches and racks. Wearing an apron was compulsory. Due to paucity of research grants the scholars had to share the apparatus and often had to wait for days till the apparatus was available to carry out an experiment. Regarding the programme of research work the broad problem was given to us by our guide. We had to make our own plan of work in consultation with our teacher. Library work was in the daily programme and we had to report on any current development in our area or allied area of research. Our teachers did not do our library work for us. We were made to understand that as we were working for our doctorate degree we would have to help ourselves. The apparatus and chemicals had to be kept ready the day before the experiment was to be carried out. Progress reports had to be submitted everyday to the guide. There were no glass blowers. For repair of glass apparatus we had to go to the technicians in their firms, sometimes even late at night. Once I had broken a Soxhlett apparatus for extraction at ten in the night. I rushed to Harinath Dey Street at night to Satya Das, the glass blower, to repair the apparatus. We

also had to go to the suppliers, specially Bengal Chemical and Pharmaceutical Works, Manicktala, or Nadia Chemical Works, College Street, to purchase the chemicals which were immediately required for experimental work. At that period interinstitutional cooperation was commendable. Prior to purchasing the chemicals, the research scholars had to go to Presidency College and other research institutions to explore the availability of the materials. Hence the purchase of excess chemicals was avoided and this also enabled the scholars to conserve the valuable, yet meagre, research grant for other purposes. Excess spending was always avoided.

The rigorous training that the scholars had to undergo during those days created self-confidence and imparted intellectual strength which helped them to develop their future career.

The landscape of Science College has changed considerably since our student days. There was no wall facing the then Upper Circular Road now known as Acharya Prafulla Chandra Road. The main building had two spacious gates, one where it exists now and the other near the canteen. The two gates were connected by a railing. There was a third gate facing Parsi Bagan Lane. The magnificent Taraknath Palit Building could be seen from outside. Later the railing was replaced by the wall to protect the building during the riots of August, 1945. With the passage of time, more walls and collapsible gates were constructed and now the building looks like a prison. There were no tram cars plying in front of Science College. In the evening the silence was disturbed by the hissing sound of the trains which passed by Brahma Girls' School. The gardeners kept the lawns decorated with seasonal flowers. While a research

student I had seen the teachers, specially Professor S. K. Mitra, inspecting the lawns and advising the gardeners.

We assembled in the class room before time. Yet, loitering along the corridors or gathering and speaking aloud outside the class rooms was unknown to us. There was a feeling of awe and respect. Acharya Ray often visited the lecture rooms and also the practical classes which started at 1.30 p.m. He asked us about the detailed experimental procedures and was always interested to learn as to whether we were facing difficulties. I recall an event which created a stir amongst our teachers. Acharya Ray once asked me in the practical class whether I had prepared Grignard reagent and had performed any Grignard reaction. I replied in the negative. I did not know what happened. Next day Professor Prafulla Chandra Mitra came and told me to prepare phenyl magnesium iodide and then triphenyl carbinol. Once I heard Acharya Ray advising our teachers that they should be present in the practical classes. In fact, he himself always checked to see whether a teacher was always present. Our laboratory assistant, Shri Krishna Goswami helped us in our practical classes. We had great admiration for him, Shri Shyam Lal, the laboratory attendant, was a skilled technician. In the compounding room I had seen him prepare ferrous sulphate from the waste liquor from H_2S Kipp's apparatus. Our practical class continued till eight in the night. The laboratory staff-members were always with us even in the late hours. Our teachers usually started their research work at nine in the morning. I had seen most of them leaving at ten in the night. We received the inspiration in our studies and research from our teachers and from Acharya Ray. He lived in a small suite

in the extreme South Western part of the building.

After passing my M.Sc. examination in Chemistry Professor Prafulla Kumar Bose permitted me to join his research group in 1938, though the results were not then published. Acharya Ray was very happy to learn that I had started my research. At that time there were research fellowships under the Professors only, viz., Sir Taraknath Palit Professor, Sir Rashbehari Ghose Professor and Kumar Guruprasad Singh Khaira Professor. Those students who started their research work with these professors were lucky regarding getting fellowships. When I started my research work under Professor P. K. Bose, he was then a lecturer. In spite of securing first class and ranking second I did not get any fellowship.

Being impressed with my research activities in the M.Sc. programme and my interest in research, Acharya Ray had written a letter to Dr. Shyamaprasad Mookerjee to create a fellowship for me. Dr. Mookerjee declined saying that the University had not the adequate funds to provide for any additional fellowship. Acharya Ray wrote a strong letter to Dr. Mookerjee mentioning that since he had started serving the University College of Science as Palit Professor of Chemistry he had deposited his salary to the University fund. Hence he wanted a fellowship for me to be created from this fund. Acharya Ray asked Professor Prafulla Chandra Mitra, the then Head of the Department of Chemistry, and Professor Nibaran Chandra Ray, a member of Syndicate, to pursue the matter. A fellowship was subsequently created but the value was less than that enjoyed by the research fellows working under professors. At that time Dr. Radha Binod Pal was the Vice-

Chancellor of Calcutta University. When the matter regarding the sanction of the fellowship was brought before the Syndicate, Professor Nibaran Chandra Ray criticized the value of the fellowship and made Dr. Shyamaprosad Mookerjee agree to increase the value and make it at par with other fellowships. Not only was I benefitted by the award of this fellowship but many more researchers after me.

I was inspired by Acharya P. C. Ray, Professor S. K. Mitra, Professor S. N. Bose and Professor N. C. Ray in my research work which I pursued from six in the morning to midnight. My father or my brother used to come to take me home. Acharya Ray was affectionate towards me and often used to call me to his room in late afternoon for tiffin.

The second world war broke out in August, 1939, but our research work was not hampered. At that time Professor P. K. Bose received from the Board of Scientific and Industrial Research, BSIR (which is now known as CSIR) a few projects to develop the process for the production of caffeine and dettol amongst other essential war-items. We voluntarily helped the scholars who had been engaged in these projects.

In 1940 when my research work for the D.Sc. thesis was almost complete I was asked by Professor Nibaran Chandra Ray to join Lady Brabourne College as Head of the Department of Chemistry. I was not agreeable as I would have to leave Science College. Acharya Ray also vehemently opposed Professor N. C. Ray as he did not like me to give up research. Ultimately a compromise was made. I joined Lady Brabourne College but I was allowed to continue my research.

During the war our department had to solve many war problems like analysis of drugs and chemicals. Till midnight I used to work on these problems after completing my work in the Lady Brabourne College.

In 1942 Professor P. K. Bose left for Delhi as Deputy Director for Drugs and Dressings. The students working for their M.Sc. thesis under him felt helpless. I was asked by Acharya Ray and Professor Mitra to take their responsibility. A large laboratory was placed at my disposal and in 1944 I was appointed an honorary lecturer for teaching and for guiding research. The professors in the departments of Physics and Applied Mathematics had a profound affection for me and always extended help to me whenever I sought their cooperation.

Although a separate department of Applied Physics with its own Board of Higher studies was created in 1931 it was shifted to the present building in 1943. Institute of Radiophysics and Electronics and Saha Institute of Nuclear Physics came into existence during the period 1945 and 1946. This expansion was possible due to the untiring efforts of Professor Phanindra Nath Ghosh, Professor Sisir Kumar Mitra and Professor Meghnad Saha. Though they were deeply committed to teaching, research and administrative activities they were not indifferent towards the maintenance and beautification of Science College. The building and lawns were kept clean.

All the staff-members and research scholars in the various departments had a close relationship and were knitted into a tapestry like one big family. No parochialism, no hostile and indifferent attitude and no ill-feelings amongst the teachers and the students

prevailed. In this context I recall a memorable event in August 1961. Due to incessant heavy downpour there was flood in Calcutta. All the students and teachers were marooned. Professor S. N. Bose, Professor B. C. Guha, and Professor B. N. Ghosh did not leave the premises. They asked the manager of the canteen to prepare a preparation of lentils and rice, known as "kichuri". By nine we were all invited to attend the dinner. It was really a memorable night. The next day at three in the morning the water subsided. The senior teachers phoned the Police Headquarters at Lal Bazar to send rescue cars to take the students to their homes. After their departure we left the premises. Today this humanism is missing. The relationship between teachers and students seems to have undergone transformation to one having only commercial value. Sympathy, affection, fellow-feeling, mutual-respect, sharing, tolerance and friendly attitudes towards one another are slowly disappearing. All the departments are now-equipped with sophisticated equipments.

There is no dearth of manpower, technical staff and other facilities due to generous grants received from UGC, CSIR, DST, ICAR, ICMR and various other funding agencies. Yet, the spirit of dynamism, dedication and sacrifice is lacking. The interest of teachers, students and other staff-members seems to be focussed "some where" else. The time has come for us to analyse as to why this situation has developed.

It seems to me that we have no value-orientation in education at present. Education is no longer the means of developing higher ideals and finer qualities but is a means of acquiring power and money. Unless we have training on value-orientation in education from the grass root level we cannot expect dedication, sincerity and dispassionate love for work and love for profession. These are necessary in bringing about the healthy and congenial atmosphere and tranquility and love for education and profession which once prevailed in this Centre of Science.

About the University Colleges of Science, Technology and Agriculture

Parimalkanti Ghosh

THE University Colleges of Science and Technology was founded in 1914 with princely grants made to the Calcutta University by private individuals. The first such gift was received in 1912 from Sir Taraknath Palit, a barrister of the Calcutta High Court, in the form of money, buildings and lands of aggregate value of Rs. 15 lakhs for the foundation of the University Colleges of Science and Technology. Out of this endowment the oldest building in the Rajabazar campus (Sir Taraknath Palit Laboratory) was constructed and two chairs, one for Physics and one for Chemistry, were created and maintained. Shortly afterwards, in 1913, Sir Rashbehari Ghose, a distinguished advocate of the Calcutta High Court, made a princely gift of Rs. 10 lakhs "for the promotion of Scientific and Technical education for the cultivation and advancement of Science, Pure and Applied, amongst my (Sir Rashbehari Ghose's) by and through indigenous agency". Four Chairs, one each for Applied Mathematics, Physics, Chemistry and Botany with special reference to Agriculture were created in 1914 out of the income of this endowment.

In 1919, Sir Rashbehari Ghose placed at the disposal of the University another princely gift, amounting Rs. 11.43 lakhs in $3\frac{1}{2}$ per cent Government securities (annual income Rs.

40,000/-) to be applied exclusively for the purposes of technological instruction and research. Out of this, two Chairs, one in Applied Chemistry and the other in Applied Physics, were created.

Another munificent grant followed from Kumar Guruprasad Singh of Khaira to provide a boost to Post-Graduate education in Science. Out of the income from this endowment, three Chairs in Science, one each in Physics, Chemistry and Agriculture, were created.

The University Colleges of Science and Technology was founded in the wake of the Swadeshi Movement that followed the partition of Bengal (1905). The condition formulated in Sir Rashbehari Ghose's proposal for endowment is a reflection of the spirit of that movement in the educational field in Science and Technology. In the last century, the Indian Association for the Cultivation of Science was founded by Sir Mahendralal Sircar with the same objective but its impact remained small mainly due to paucity of funds. The condition "by and through indigenous agency" was translated into the stipulation, uniformly applicable to all endowed Chairs mentioned above, that the "Chairs be always filled by Indians (that is, persons born of Indian parents) as contra-

distinguished from persons who are called Statutory Natives of India. This stipulation did not mean any lowering of standard in the selection of Professor as there had been a provision for getting the selected person trained for 1-2 years under specialists in Europe, America, Japan or such other place outside India as the Senate may determine at the cost of the University (funds be provided for from Ghose or Palit endowments). This is established by the fact that five of the teachers (not necessarily Professors) appointed during 1914-1919 were later elected Fellows of the Royal Society (London) and one of them became a Nobel Laureate. The condition about nationality of a Professor in an endowed Chair increased the apathy of the foreign rulers towards the nascent institution (rather the apathy was both prenatal and postnatal). The Chancellor of the University (the British Lieutenant Governor of Bengal) did not lay the foundation stone of the first building (Palit Laboratory) of this University College. In March 1914, it was laid (in fact, very well laid, as time has shown) by Sir Asutosh Mookerjee, the then Vice-Chancellor of the Calcutta University, who had been instrumental in procuring the munificent gifts to the University. Besides the Chairs mentioned above, some endowed Chairs were created out of private gifts in later years (but before independence). Those who pursued research work in those days had to work against tremendous odds due to paucity of funds. But they worked undaunted, perseveringly.

In 1914, Professors in Palit and Ghose Chairs were appointed. The first Professors were as follows :

Palit Professors

Prof. Prafulla Chandra Ray (Chemistry)
Prof. C. V. Raman (Physics)

Ghose Professors

Prof. Ganesh Prasad (Applied Mathematics)
Prof. Debendramohan Bose (Physics)
Prof. Praphullachandra Mitter (Chemistry)
Prof. S. P. Agharkar (Botany)

Post-Graduate Classes in Physics, Chemistry and Applied Mathematics were opened in the middle of 1916. Amongst the lecturers appointed were S. K. Banerjee (Applied Mathematics), S. N. Bose, M. N. Saha, and S. K. Mitra (Physics), J. C. Ghosh, J. N. Mukherjee and P. Ray (Chemistry).

S. N. Bose and M. N. Saha were also lecturers in Applied Mathematics. Bose and Saha stood first and second in Mathematics (Honours) and also in M. Sc. (Applied Mathematics, then known as Mixed Mathematics) from the Presidency College with very high scores. I am giving this background for narrating an amusing story about their being lecturers in Physics. Bose had gone to some gentleman's house to attend a marriage party. He heard a few senior people discussing about the state of affairs in the Calcutta University at that time. One of them exclaimed, "See what is the state of affairs in the Calcutta University! People who have not read Physics are teaching Physics in the M.Sc. classes there!" Bose listened to this criticism silently. This story I heard from Professor S. N. Bose when he was the Khaira Professor of Physics in the Calcutta University.

Professor Ganesh Prasad was the Ghose Professor of Applied Mathematics from 1914 to 1919, and then left to join the post of the Hardinge Professor of Higher Mathematics (Pure Mathematics). Professor S. K. Banerjee succeeded him as the Ghose Professor of Applied Mathematics in 1919. He also soon

left the post to join the Meteorological Department, Govt. of India. Professor N. R. Sen was appointed the Ghose Professor of Applied Mathematics in 1922 but he joined some time later and continued as the Ghose Professor of Applied Mathematics and the Head of the Department till 1959 when he retired. It is during this period that research and teaching in Applied Mathematics developed in different directions. Before Professor N. R. Sen became the Ghose Professor, teaching and research in Applied Mathematics were restricted to various branches of Mechanics, Astronomy and Geodesy and Geophysics. He happened to be a direct pupil of Max Planck, Albert Einstein, Arnold Sommerfeld and Max Von Laue. Under his leadership courses were introduced in various branches of Mathematical/Theoretical Physics like Electromagnetic Theory, Electron Theory, Relativity (Special Theory and General Theory), and Thermodynamics and Statistical Mechanics. He also introduced special papers on Ballistics and Compressible Fluids. Compulsory courses in Analysis were upgraded and a compulsory course in Numerical Analysis (theoretical and practical) was introduced. Significant research contributions were made in these branches besides the branches mentioned earlier. Professor N. R. Sen himself conducted research work in Fluid Dynamics, Relativity, Quantum Mechanics, Astrophysics and Ballistics. Research work was also done in the Department in modern Mathematical Methods of Applied Mathematics. A weekly colloquium titled the Physico-Mathematical Colloquium was held on Tuesdays to discuss and study research papers. From 1945, a weekly seminar for the improvement of knowledge of Mathematical Methods for research workers in Applied Mathematics was started by him and continued to be held on Thurs-

days till his retirement. Fortunately for me I turned out to be the only speaker during his period. I say 'fortunately' because this weekly engagement enabled me to learn various modern mathematical methods. The Numerical Laboratory and the Hydrodynamical Laboratory of the Department were started by Professor N. R. Sen in 1936 and 1957 respectively. It is worth mentioning here that like Professors in other Chairs of scientific subjects created in 1914, the University Senate (1914) made it one of the duties of the Sir Rashbehari Ghose Professor of Applied Mathematics "To superintend the formation and maintenance of the Laboratory of the College of Science in his own subject". The Department of Applied Mathematics of the University College of Science became a unique centre for study and research in Applied Mathematics in India. In appreciation of the research done during this period the Department was recognized by the UGC in 1963-64 as the Centre of Advanced Study in Applied Mathematics—the only one of its kind in India.

I entered the Department as a student in July, 1938 after passing B.Sc. with Mathematics Honours in the same year. As an undergraduate I had looked through the then iron railings (parallel to the Upper Circular Road, now renamed Acharya Prafulla Chandra Road) at the impressive building (Palit Laboratory) of the College of Science but never dared to enter the College compound. I was very much afraid of the people working there. On the day of my first coming to this college I came armed with necessary documents like the fee book and a letter from the Department of Applied Mathematics which gave the date of starting of the classes and a time-table for our classes (the then 5th year classes) lest somebody might challenge and thwart my entry into

the College. I asked the durwan on the ground floor (later I came to know that his name was Janakiram) which way the Department of Applied Mathematics was and went there without any hindrance. In this Department, there were very eminent teachers like Dr. N. N. Sen, Dr. S. Ghosh, Dr. B. S. Ray and Dr. S. C. Kar. Dr. S. Ghosh taught us Analysis and Differential Equations. He was a very thorough teacher and a very strict man. He was a very famous specialist in the mathematical theory of Elasticity. In view of strictness, we students describe him as specialist in elasticity of materials and rigidity of principles. Dr. B. S. Ray was most accessible to us and inspired me to learn many subjects through personal discussion with him. From him we heard stories about mathematicians in Göttingen from where he got his Ph.D. (Dr. Phil-Nat. rer.) degree under Professor Max Born. The UGC has now arranged to show a film on Göttingen—the most renowned Centre for mathematics in Germany before the World War II. Dr. N. N. Sen was soft spoken and easily accessible but we dared not to approach Dr. S. Ghosh unless it was absolutely essential. Here I had the good fortune of studying my special papers. Electromagnetic Theory, Electron Theory and Relativity (Special Theory) with Dr. S. C. Kar and after passing my M.Sc. I attended his classes on Thermodynamics and Statistical Mechanics. Later I joined as a Sir Rashbehari Ghose Research Scholar under Professor N. R. Sen to study and work mainly on Quantum Mechanics. Before completing my full term of three years I left the scholarship and joined in 1945 as a lecturer in Mathematics in the Bangabasi College, Calcutta. I continued my research studies in the Department of Applied Mathematics but as an independent part-time research worker. In 1947-48 I worked in the

Department as a Part-time Lecturer for one year, teaching Numerical Analysis. I have the pride to be on academic staff of the College of Science along with such eminent men like Prof. S. N. Bose, Prof. M. N. Saha, Prof. N. R. Sen, Prof. S. K. Mitra and many others but outside our own Department I was most closely associated with Prof. S. N. Bose. He came back to this University as the Khaira Professor of Physics in 1945. We (some M. Sc.'s in Applied Mathematics/Physics) approached him to preside over a weekly seminar on Quantum Mechanics to be organized by us. We persuaded him to agree to our proposal but unfortunately the seminar had a short life. However, intellectual friendship between the first generation and the third generation (he was a teacher of some of our teachers) remained growing. In 1950, I was appointed a temporary whole-time lecturer in a newly created post for teaching Numerical Analysis—theoretical and practical (a post in which I later became permanent). My joining date was 1st December, 1950 but on that day Prof. N. R. Sen was to deliver a lecture at I.I.T., Kharagpur. He directed me to report my joining the post to Prof. S. N. Bose, the then President of the Post-Graduate Council in Science, in the forenoon of 1st December, 1950 and he told me that next day, on hearing from Prof. S. N. Bose that I had duly joined, he would report my joining to the Secretary, Post-Graduate Council in Sciences. I did as I was directed by Prof. N. R. Sen. Next day he went to Prof. S. N. Bose taking me along with himself. He enquired of Prof. S. N. Bose whether I had duly joined on 1st December, 1950. The latter replied, "Parimal joined duly yesterday, on 1st December 1950. While handing over to you this young man, I would request you to give him the powers of a deputy secretary, *i.e.* all papers

regarding development of the Department should be accessible to him. Ultimately one day he will take charge of the Department and so he should be acquainted with all our plans." Prof. N. R. Sen readily agreed. Prof. S. N. Bose's good wishes came to be realized on 1st March, 1974 when I took charge of the Department as the Head of the Department. I was then a Professor (UGC) in the Department. Later in 1977 I became the Ghose Professor only when the University offered me the post in the old grade for which I had opted earlier as a Professor (UGC). After retirement of Prof. N. R. Sen Dr. S. Ghosh became the Ghose Professor of Applied Mathematics at a very advanced age and retired in a little less than three years. He made efforts for the development of the Hydrodynamical Laboratory of the Department.

After the retirement of Prof. S. Ghosh, Prof. S. K. Chakrabarty became the Ghose Professor of Applied Mathematics and Head of the Department in 1974. He had the good luck of having an opportunity for operating the scheme for Centre of Advanced Study in Applied Mathematics, a scheme practically drafted by him. But he was confronted with a terrible problem of shortage of space which is really a congenital problem of the Department. He established a Seismological Laboratory with UNESCO aid (Russian contribution). Research in Seismology got a stimulus. He also introduced the study of fundamentals of computer science (theoretical and practical) as a compulsory subject, increased the stress on teaching of Methods of Applied Mathematics, introduced Magneto-fluid Dynamics and Plasma Physics as an elective subject, and revived the special papers on Quantum Mechanics and encouraged research in these

subjects. New posts were created and some new academic staff were recruited. The Department gained in stature. He retired with effect from 1st March, 1974.

After the retirement of Prof. S. K. Chakrabarty, Prof. P. K. Ghosh (then a UGC Professor) became the Head of the Department with effect from 1st March, 1974 and later in July 1977 he became the Sir Rashbehari Ghose Professor of Applied Mathematics. He also continued as the Head of the Department till his retirement (effective from 1st March, 1982). During these nine years the Department (including the CAS) developed in three directions: increase of staff positions, more recruitment of academic staff, diversification of courses of studies, increase in volume and quality of research work. Courses on Methods of Applied Mathematics were strengthened by the inclusion of Applied Abstract Algebra, and Lie Groups. Graph Theory, Topology and Functional Analysis, Stochastic Process were strengthened, Statistical Mechanics, Dynamical Oceanography, Dynamical Meteorology, Elements of Optimization and Operation Research II, Elements of Control Theory, Elements of Mathematical Economics and Elements of Mathematical Ecology were introduced as elective half papers. New special papers on Advanced Computer Science and Cybernetics and Advanced Optimization and O. R. were introduced. All preparations were made so that special papers on Galactic and Extragalactic Astrophysics were introduced from July 1974. A Cybernetics Laboratory was also started in the Department in 1978. In appreciation of the increased activity of the Department a Special Assistance Programme (Centre of Advanced Study) was formally sanctioned by the UGC in 1989.

Reminiscences from a Mental Diary

S. N. Roy

WHO would not have a feeling of nostalgia when asked to travel down memory lane and report on his Alma Mater? Indeed, the University of Calcutta has acted as a bounteous foster mother in nurturing sustenance and growth in me, in my studentship, and career as well; that is why even to-day when I visualise myself passing along the corridor of the University College of Science building at Acharya Prafulla Chandra Road, Calcutta, I perceive, feel and enjoy a rare feeling of rapture and ecstasy that beggar narration.

I came under the banner of the University just 58 years ago when I entered the precincts of Vidyasagar College, Calcutta, in the year 1931, and was allotted a Registration Number by the University. My choice of Experimental Psychology as a subject of study was made apparently by accident, but factually through a process of elimination of those subjects which a couple of my very close friends did opt for. None of those subjects I wanted to repeat and my choice rested on a challenge for knowing that was unknown to me. However, this choice have had a far reaching impact upon my study, research, career and life.

In 1940, I was awarded the Jubilee Research Prize and a gold medal on the basis of my thesis, "Psychological determinants in the choice of Vocation" and my Ph.D. thesis

was also confined to a similar field. Incidentally, the collection of the valuable data involved in the study was possible because of the very cordial participation of a galaxy of successful men in the profession of Medicine and Law. I am prompted to quote a few names like those of Dr. B. C. Roy, Sir Nilratan Sarkar, Sir Asoke Roy, Dr. Ganapati Panja, Sri A. N. Chaudhury and Sri B. C. Chatterjee of the famous Bhawal Case along with the then sitting Judge Sri C. C. Biswas. They had shown a keen interest in my problem and rendered co-operation which was considerable.

At this stage, it would be fair to delve on the origin of the study of Psychology in the country. A systematic study and research in Psychology began for the first time in 19'6 when the Post-graduate Department of Experimental Psychology was opened by Sir Ashutosh Mookerjee in this University. However, the department initially could not keep pace with sister departments like those of Chemistry or Physics, which came into existence in the same year. The Silver Jubilee Session of Indian Science Congress in 1938 at Calcutta stirred up the potentials for further greater and broader advancement of science in this country. The presence of eminent Psychologists like Prof. C. J. Yung, Prof. C. Spearman and Prof. C. S. Myers, on the occasion of the Congress, gave a new turn and impetus to the Department of

Experimental Psychology. On the strong advocacy of Prof. Myers and with the patronage of Dr. Syamaprasad Mookerjee, the then Vice-Chancellor, the foundation of Applied Psychology was laid in India.

Thus, the Applied Psychology Section was created and attached as a research wing to the Department of Experimental Psychology in the month of August, 1938. This was soon followed by other changes. The prefix Experimental was dropped, the Post of Professor of Psychology was created and Dr. G. Bose was elevated to this post in 1940.

The next Vice-Chancellor to remember in the matter of rendering another turn to the growth and development of Applied Psychology was Sir J. C. Ghosh. In 1954, he appointed an Advisory Committee with Prof. S. N. Bose, Dean of the Faculty of Science as the Chairman and Prof. S. C. Mitra, Head of the Department of Psychology, as Convener, to consider and suggest re-organisation of the Applied Psychology Section for greater and better functioning. The committee made an unanimous recommendation for upgrading the Section as an independent Technology Department of Applied Psychology with a three year post-graduate course leading to a degree.

However, for difficulties, technical and otherwise, the recommendation had to be modified and a two year M.Sc. Course in Applied Psychology under Science, instead of Technology, was finally recommended by the Advisory Committee in 1957 which was approved by the University.

The onus to complete the square came upon Dr. S. N. Sen, Vice-Chancellor, under whose leadership the Department of Applied

Psychology came into existence in 1969, with myself as the Head of the Department, followed by elevation to the newly created post of Professor in 1970. The nascent department also received dynamic support that flowed in spontaneously from Pro-Vice-Chancellor Prof. P. K. Bose and Sri H. M. Majumder, and others in the administrative and academic wings of the University.

Earlier in February of the same year, an approach was made to the University Grants Commission for extending its assistance to the developmental needs of the department. The U.G.C. was very quick in extending its response and granted not only full approval of every item in the blue-print that was prepared by me in respect of additional needs for staff, space and equipments, but shared cent per cent financial liability, non-recurring and recurring, to cover those till the end of the 4th plan period. The State Government also did not lag behind in extending its support by way of a commitment to shoulder the entire financial liability of recurring expenditure in continuation upto the end of the 4th plan period and the commitment was fully respected.

In the context, I can visualise certain scenes, relevant to me, and interesting otherwise, which bespeak of the rationale and motivation that worked behind the organisation and growth of the department.

On 27th August, 1938, just at 11 a.m. I stepped in the room of Dr. G. Bose, Head of the Department of Experimental Psychology to pay him my compliments and to seek his blessings on the day of my joining the newly founded section of Applied Psychology as a Research Assistant on Rupees Seventyfive per month. Dr. Bose suddenly remarked.

"The future of Applied Psychology is dark" I was then nurturing a rosy dream about the prospects of bright future of a temporary research wing I was just joining. His remarks generated in me a challenging and spontaneous retort. "I shall make the future of Applied Psychology bright, Sir". Long three decades thereafter the Applied Psychology Section was transformed into a full-fledged and independent department. I now understand how, thus, the great psychologist was successful in stimulating and provoking the next generation into creative activity.

It was 1936 and I will refer to two memorable incidents during this time. It was a recess period and I, with three of my classmates, was coming down by the eastern staircase. We were stopped at the landing of the first floor by Acharyya P. C. Ray with his hands locked behind and looking askance at us. "Who are you?" questioned he. I replied, "Students, Sir." Frowning he said, "Which department?" I was scared, and replied, "Experimental Psychology, Sir". (The word 'Experimental' was dropped in the year 1939) "H'm you have no class? Where are you going?" he came closer. I answered, "We are going for tea, Sir". He exclaimed, "What, Tea?" and quite unexpectedly giving a hard punch on my abdomen he went on saying, "With this frail health you take tea? Don't you know what a poison it is?" He continued showering counsels and threats alternately till I agreed to take grams and molasses every morning. Very much annoyed I felt at this unwarranted attack of Acharyya-dev but I was too small and scared as well to express the same against such a gigantic personality. What I did however in way of self-adjustment would appear to be rather amusing. I abandoned that route for the tea shop adjoining science college and started

availing the staircase on the northern side. And secondly, after, trying grams and molasses for several days I made myself tension free by thinking. "A blow from such big a man must be a blessing in disguise". I still feel that I had his blessings. The second incident during this time was about the teashop just mentioned, the owner of which was old Chuni Babu. One day finding sand-grains in the outlet served I rebuked the restaurant boy in a loud voice. Chuni Babu, resting perhaps in the adjoining room, came out and taking my cause reprimanded the boy for this sort of carelessness on his part. Then very calmly he addressed us, "Well my boys, it is definitely bad to serve foodstuff which may crack one's teeth but there is no adulteration in it I assure you. Do you know that Meghnad Saha, Jnan Mukherjee, and others used to come here when they were students? If they could become so big by taking tea and snacks here, do you like to be exceptions? Well, the so called sand particles in the outlet are like vitamin granules,—there is nothing to be worried or afraid of—eat freely if you want to be 'big'." and with these words he burst into an unassuming hearty laughter.

One day in 1939 or '40, I remember Pandit Jawaharlal Nehru quite unexpectedly stepped into our laboratory, room no. 16. It was perhaps some holiday, I mean, there was none in the department except me and two bearers. Pandit Nehru enquired about the departmental activities, how intelligence, emotions, reaction-time were measured and so on. His impressive, glittering and penetrating pair of eyes still linger with adoration in my mind as do the eyes of Dr. Shyamaprasad Mookerjee with whom I had a very affectionate relation. I recall very fondly in this connection my close association with Prof. Satish Chandra

Ghosh from my early days in the University till he left us for the other world.

Who can forget philosopher-scientist Professor Satyendranath Bose in whose contact I was privileged to come and whose guttural laughter still linger in my ears. In 1954, in one expert committee meeting, he, as the Dean of Science, and virtually the Chairman, convincingly asserted that the Calcutta University should have Applied Psychology Department under the faculty of Technology.

The future of Applied Psychology is bright; it is particularly so in India where there is a new awareness of its utility. And, there is enough scope in this vast country of ours where little has been done for human resources development. In this historic hour of the country's reconstruction, the Applied

Psychology Department of Calcutta University, therefore, has a task onerous. The department has in the earlier decades made it possible to sow seeds of study, research, propagation and undertaking of various projects for the society's benefits. In its present phase also, it is vibrant with activities. Let us hope, pray, plan and resolve for dedicating ourselves to the cause of Applied Psychology. I dream and I visualize that within a foreseeable future, our department will earn enough growth and achievement, experience and reputation that will inspire and stimulate us for contributing our might in the country's significant leap, in the profound sense of the term, to the 21st century.

Long live the Department of Applied Psychology, long live the University of Calcutta.

Physiology : An Overview of an Old Student

A. K. Deb

PHYSIOLOGY as a basic science, outside medical studies, was the creation of Prof. S. C. Mahalanobis in Calcutta University in 1909. Initially it was housed at Presidency College with Prof. Mahalanobis as the only teacher. At the beginning, Prof. Mahalanobis taught Botany as well as Physiology. In 1911, N. M. Basu and S. P. Neogy were the first Post-Graduate students of Calcutta University. In our time, *i.e.* in the late twenties, Prof. N. C. Bhattacharya, also former Lecturer of Botany used to teach Physiology in the Department of Physiology along with Prof. N. M. Basu and Dr. S. M. Banerjee. Dr. B. B. Sarkar of Physiology Department in Science College taught Endocrinology in Baker Laboratory of Dr. U. N. Bramhachary, the discoverer of the Stibamine in the treatment of Kala-azar. He used to take a few classes on Biochemistry in a stuffy factory room in Science College. His scholarly lectures were hardly understood by students. Prof. P. B. Sen gave us guidance in Biochemistry Practical in a small laboratory then available in Science College.

In 1938, the Post-Graduate Department of Physiology was shifted to University College of Science at 92, A. P. C. Road. In 1934, Physiological Society of India was established by the conjoint effort of Prof. S. C. Mahala-

nobis, Prof. N. M. Basu and Sir N. R. Sarkar. The first journal of the Physiological Society of India was published in 1946. Post-Graduate Study of Physiology began to progress in great strides since the termination of World War II. The credit of serious research work in the Physiology Department of Science College must be given to earlier teachers like Prof. B. B. Sarkar, Prof. P. B. Sen and Dr. N. N. Das. Dr. Das was specially interested in Electroencephography. Following the pioneers mentioned above Prof. S. R. Moitra took all the responsibilities on his shoulder for decades in the development of different branches of Physiology, particularly in work-sports and Exercise Physiology. I had the good fortune in teaching in this department as a part-timer for a decade. At present research activities are being carried out in full swing by the highly qualified and energetic new batch of physiologists in the following areas :

- i) Biochemistry.
- ii) Endocrinology, Reproductive Physiology and Family Planning.
- iii) Sports, Exercise and work Physiology.
- iv) Applied Nutrition & Development of Manpower.

- v) Ergonomics and its application in industry.
- vi) Environment Pollution & Immunity.
- vii) Biophysics & Electrophysiology.
- viii) Comparative Physiology of various Animals.
- ix) High altitude Physiology.
- x) Neurophysiology in the study of the functions of different areas of brain.
- xi) Plasmid Encode Antibiotic Resistance in bacteria.
- xii) Courses are also run on Dietetics, Biostatistics, Chronobiology and Microbiology.

From the formidable test it is evident now from the embryonic stage that there is a

phenomenal growth and development of physiology to maternity covering almost every sphere of biological existence in our planet. One problem, however, that is looming large in its solution is how to control the population explosion of our country which is hindering the progress of India to a satisfactory extent. Nevertheless from the trend of progress we may hopefully expect the prospect of 'Health for all' in the 21st Century.

It is encouraging to note that presently there is arrangement for 50 students per year, including 11 in Presidency College for post-graduate study of Physiology in its rapidly spreading sphere of activity. This shows that interest in the study of Physiology is increasing by leaps and bounds over the years. The fillip in research activities is primarily due to prof. S. R. Moitra who dedicated his entire life to development of Physiology.

The Department of Geography —a Platinum Jubilee Resume

Kanangopal Bagchi

ON this occasion of the Platinum Jubilee of the foundation of the Science College of the University of Calcutta, a resume of the Department of Geography, is being presented, 1989 incidentally being the Golden Jubilee year of its foundation. The idea of mootng a department of Geography was presented in a meeting of eminent scientists gathered on the occasion of the Silver Jubilee Celebrations of the Indian Science Congress Association in 1938. The Celebrations were sponsored jointly by the Indian Science Congress Association and the British Institute of Science. Those present included Dr. L. D. Stamp-Dr. Ogilvi, Dr. A. M. Heron, then President of the Section of Geography, Prof. M. N. Saha, Dr. D. N. Wadia, Dr. W. D. West, Dr. S. P. Chatterjee, D. P. Ghosh and others. Syamaprasad Mookerjee presided. I had the occasion to be present as a student member doing my M.Sc. in Geology.

The department took shape in 1939, thanks to the dedicated efforts of Dr. S. P. Chatterjee and patronage extended by the then Vice Chancellor, Symaprasad Mookerjee, catering to the Honours students at the first instance. The Post Graduate classes were introduced in 1941. The syllabus for Post Graduate, as well as Honours courses were patterned after the British Universities, but with emphasis

on India. The discipline was included in the science faculty and laboratory practical, field work and dissertation were compulsory items. Special papers included geology, pedology, meteorology and cartography for those graduating with science and cultural landscape, Political geography and Historical geography for students coming from the humanities stream. The department used to be run on a temporary basis with a skeletal whole time staff and a number of honorary lecturers drawn from allied departments—Mathematics, Anthropology, Chemistry, Engineering *etc.* Besides S. P. Chatterjee, founder teachers included Dr. B. N. Mukherjee, D. R. Mitra, Dr. B. Set, N. K. Bose and Dr. S. K. Mukherjee. Those who joined within a couple of years included Bikas Bose, K. S. Gupta, K. Bagchi and B. N. Ganguli.

The second world war broke out soon after the department was launched resulting in considerable financial strain just when funds were needed generously for infra-structural development. Imports of books and equipments ceased altogether and requirements had to be met from innovations. This, however, resulted in closer contacts between teachers and scholars and inter institutional collaborations. Specimens and micro-sections of representative rocks, minerals,

fossils and microsections were made available from the Geological Survey of India and the Indian Meteorological Department admitted students of meteorology to its observatory for practical observations. While study and research went on as best they could, a socio-economic convulsion seized the country due to a famine, the 'Bengal famine', as a sequel to war efforts based on Calcutta which had been made the Headquarters of the South Asian Command of the 'allied' forces. In addition the Quit India movement of Mahatma Gandhi heightened the anxiety of the elite who were involved with education. The Geography Department however adapted to the situation by participating in socio-economic surveys resulting in the production of an 'Atlas of Bengal' patterned after E. Dz. Martonne's *Atlas Dz France* proved a tremendous success and brought high recognition to Dr. S. P. Chatterjee who executed the project. Also during this time was published a monograph on Ganges Delta by the University of Calcutta authored by K. Bagchi which set out the complexities of environmental adaptation to delta dynamics.

Then came the partition of India and creation of the two wings of Pakistan in 1947. India was declared a republic in 1950 and the U.G.C. came into being in the early fifties. It was now possible to stabilise the department through Government grants and sponsor research. Land use studies were undertaken by the department on the model of the survey of land use study of Britain by L. D. Stamp. The district of Howrah revealed the pattern of land use then in vogue and provided the base for planning, particularly in regard to rehabilitation of refugees. The cartographic exercises impressed Pandit Jawaharlal Nehru, the Prime Minister and a scheme for the production of National Atlas, first in Hindi and

subsequently in English resulted in the creation of a National Atlas Organisation of the Govt. of India. The Professor of Geography of Calcutta University, Prof. S. P. Chatterjee, continued to be the Hon'y. Director in addition to his teaching assignments.

During the sixties the Department came forward to formulate a diagnostic survey—the first of its kind in India—in collaboration with the Universities of Patna and Jadavpur and the I. I. T., Kharagpur under the aegis of the Planning Commission. The Technical Advisory Committee conducted the survey and finally reports were drawn up which ran into five volumes. K. Bagchi of the Department of Geography, Calcutta University edited the Reports. Also during this decade, in 1968 to be precise, through the efforts of Prof. S. P. Chatterjee was convened an international Geographical Congress in Delhi. Prof. Chatterjee was by then, succeeded by K. Bagchi as head of the department and through the decade of seventies Prof. Bagchi organised a number of interdisciplinary studies on problems of hydrology (Bhagirathi-Hooghly Basin), agriculture (Agricultural Problem of India), regional planning (Problem of Regional Planning) *etc.* The collaborators included economists (Economics dept, C. U.) Statistician (Indian Statistical Institute) Hydrologists (Institute of Port Management) engineers (Institute of Engineers) Geologists (Geological Survey of India) the Government Departments of West Bengal and the River Research Institute, Calcutta.

Around mid seventy the need for strengthening the study of social aspect of geography was keenly felt as complimentary to physical components and a Professorship in Social Geography was created. Dr. B. Banerjee was appointed to the Post. From mid seventies to

early eighties, the thrust of the department was directed on investigation of regional characteristics. Projects such as diagnostic study of the Ganga Delta (sponsored by West Bengal Govt.), Rarh Bengal and North Bengal Plains Sponsored by the University) were undertaken and reports published. Also under-

taken was a land use survey of the problem areas of Eastern India under the aegis of the U.G.C.

Prof. Bagchi was succeeded by Prof. B. Banerjee in 1983 who were in their turn succeeded by Prof. S. Bhattacharya, Prof. S. N. Mukherjee and Prof. S. C. Mukherjee.

Vision of Sir Asutosh and the First Laboratory of Psychology in India

S. K. Bose

THE first laboratory of Experimental Psychology, as is well known, was officially born in Leipzig in 1879. The first laboratory of Experimental Psychology in India was opened in Calcutta about thirty-six years later. The honour of having the first such laboratory in Asia goes to Japan. In the sphere of education, India was closely associated with Great Britain while Japan with Germany towards the end of the 19th century. The outcome was that at the time the Japanese scholars imported Experimental Psychology to their seats of learning, the subject was very little known in the Indian academic circle. One wonders what exactly roused Sir Asutosh Mookherjee's enthusiasm for this new subject as early as in 1902 or 1903. Long ago a senior professor told us in a casual way that Sir Asutosh being a mathematician *par excellence* was, perhaps, impressed by the methods of psychophysics in the measurement of mental phenomenon.

Scholars from the different parts of Europe and America who came to Leipzig in 1879-80 returned to their respective places after two or three years and started centres of study of the "New Psychology", as it was called

by Scripture. Asutosh Mookerjee, who was then planning to introduce at the Calcutta University post-graduate courses of studies in various disciplines of arts and science, decided to include Experimental Psychology in his list. At his request the versatile scholar Dr. (Late) Brojendra Nath Seal prepared the syllabus which comprised four theoretical and four practical papers. When in 1905 he prepared the syllabus for post-graduate course of study he took Leipzig as the model, but got best guidance from the Universities of Clark (Hall), Cornell (Titchener) and Harvard (Münsterberg).

Dr. N. N. Sengupta returned to India having received training for 5 years in Experimental Psychology under Hugo Münsterberg at the Harvard University, U.S.A. Before returning to Calcutta in 1915 he knew that he would be asked to organize the laboratory of Experimental Psychology and advisedly familiarized himself with the technique of study being followed at Cornell by Titchener, who was said to be the spiritual successor of Wundt. Cornell was following Leipzig in the main, and by following Cornell Calcutta came under the orbit of influence of Leipzig.

Sengupta was given the responsibility of setting up the laboratory and to organize courses of teaching in November, 1915. The start was made with a single room in the ground floor of the University College of Science at 92 Upper Circular Road, (now called Acharya Prafulla Chandra Road) with N. N. Sengupta as the only whole-time teacher in charge of it. The Department of Experimental Psychology, the first one in Asia, was formally opened in the beginning of 1916 with one student, who had been admitted in the post-graduate course of study in 1914 in anticipation of opening of the Department and was permitted to do practical work in the Physiology Laboratory of the Presidency College under the supervision of Professor S. C. Mahalanobis. Earlier in 1908, a graduate student applied for permission to study Experimental Psychology but he could not be given facilities for the same at that time. The name of the first and only student was M. N. Banerji, who passed out in September, 1916, and was immediately appointed a lecturer to assist N. N. Sengupta.

In 1916, the first regular batch of students was admitted. Amongst them were Haripada Maiti and Rangin Haldar. G. Bose also joined the Department at that time as a casual student. He was a noted medical practitioner with brilliant academic career. In his B.Sc. examination he had obtained Double Honours, first class in Physiology and Chemistry. He was the leading mental disease specialist of his time with original work in Abnormal Psychology to his credit. Because of his high attainments (almost 100% marks) he was permitted to appear at the M.Sc. examination in one year, *i.e.* in 1917, as a special case, and even before publication of the result he was appointed a part-time lecturer in Abnormal

Psychology. Two years later he was awarded the D.Sc. degree and was thus the first D.Sc. in Psychology of the Calcutta University.

The Department could not fully cope with the teaching load with three teachers only. Hence part-time services of several teachers from the Departments of Philosophy, Zoology and Physiology had to be requisitioned in the beginning. From 1918 the Department started producing regularly trained scholars. Some of those who passed out during 1918-21 were recruited in the teaching staff. By 1922 the services of all part-time teachers excepting one from other departments or colleges could be dispensed with.

In 1920 Psychology Honours course of study was started.

At that time the Calcutta University had no post of reader in any Department. Professorship in Psychology had not been created yet.

Having got a team of competent teachers and a fairly good laboratory set-up N. N. Sengupta carefully chose the students, maintained a high standard of teaching and introduced research programme in collaboration with his colleagues in 1923. Such was the enthusiasm for research of the teachers and the students that in those days they worked in the laboratory from early morning to late evening. An additional incentive for research was provided in 1924 by the fact that the Indian Science Congress Association accepted the proposal to have a Section of Psychology from 1925. That provided opportunity to present scientific papers to the Science Congress in its annual sessions. It may be mentioned in this connection that the Department's plea for opening the Section of Psychology, though

ably piloted by N. N. Sengupta and G. Bose, would not have been so readily accepted but for the strong support lent to it by P. C. Mahalanobis and C. V. Raman. The first meeting of the Section of Psychology under the chairmanship of N. N. Sengupta took place during the session of the Indian Science Congress Association at the Banaras Hindu University in January, 1925. Research papers prepared at the Calcutta laboratory were read and well received. The psychologists present at that meeting decided to form an Indian Psychological Association and to start an Indian Journal of Psychology as its official organ to be published quarterly. N. N. Sengupta was the first President of the Indian Psychological Association and the first Editor of the Indian Journal of Psychology. The first number of the journal appeared in January, 1926. Calcutta University agreed to print the journal at the University Press free of cost and did so for more than twenty-five years.

The reputation of the Department spread, and bright students from different parts of the country were attracted. Subhas Chandra Bose (Netaji) was a student of the post-graduate class for a few months in 1919—before he left for England to appear at the Indian Civil Service examination. Young teachers of Psychology of other Universities were sent to Calcutta for short course of training in laboratory techniques. To name a few were B. L. Atreya of the Banaras Hindu University, Indra Sen of the Delhi Hindu College, Muhammad Aslam of the Lahore Government College, R. Rath of the Cuttack Ravenshaw College, K. L. Srimali of Udaipur Vidyapith and Bahadur Mall of the Punjab chain of D. A. V. Colleges.

In the selection of research topics in those early days the emphasis of the Calcutta laboratory was upon experimental work relating to some classical studies by Wünder, Külpe, Fechner, Ebbinghaus and others. The object was either to supplement these studies by further experimentation or to examine some aspects of these from a new angle. In laying down the experimental procedure the technique of the structural school was mainly followed. The findings were mostly published in the Indian Journal of Psychology and were appreciatively reviewed in the foreign journals.

The first phase of experiment-oriented research activities in the Wünderian tradition may be said to have ended with the departure of N. N. Sengupta in July 1929, to the Lucknow University where he was offered the chair of Philosophy and Psychology.

G. Bose took over charge of the Department from N. N. Sengupta in July, 1929. Being an active medical practitioner he did not accept the whole-time appointment but was permitted to continue as a part-timer in charge of the Department. The designation of "Head of the Department" now came in vogue. Ten years later the Chair of Psychology was created in 1939 and G. Bose was appointed the first University Professor.

G. Bose was a man of outstanding ability and acknowledged authority on mental abnormalities. He made original contributions to the study of the origin and treatment of mental diseases. He threw new light on the nature of the unconscious. It was only to be expected that theoretical and practical researches of his time would be based on unconscious-oriented hypotheses.

Although G. Bose preferred psycho-analytical approach to the study of various mental problems he gave full facilities and encouragement to any of his associates who attempted to study a problem from a different point of view. He was interested in laboratory work and helped workers to carry out successfully studies on Conditioning of Finger-flexion Reflexes, Mirror-drawing and Motor-learning, influence of Colour in Area Estimation, Bi-aural Disparity, and such other subjects. Work of three members of the staff earned awards from the University during this period. G. Pal was awarded the D. Sc. degree in 1936. He was thus the second D. Sc. of the Department. S. K. Bose won Sir Asutosh Mookerjee Medal twice in 1936 and 1939. S. N. Roy became the recipient of the University Silver Jubilee Medal in 1950. Several useful apparatus for laboratory study were designed by G. Bose and M. Ganguli. To name some of these: Sand-motor Apparatus, Big Muscle Ergograph, Exposure Apparatus (G. Bose); Horizontal Campimeter, Retinal Rivalry Apparatus, etc. (M. Ganguli).

When G. Bose had taken over, the Department had been shifted to the 2nd floor. The accommodation consisted of two rooms and a cubicle. Admission to post-graduate classes was limited to twelve. The laboratory soon could be expanded as four rooms allotted in the attached newly constructed wing of the building. Twenty-four students could now be admitted. The staff strength also increased.

Two other important changes closely followed.

The name of the subject Experimental Psychology was changed to Psychology in 1938 as it was felt that the qualifying word 'Experimental' was no longer necessary. The

University authorities agreed to accept Psychology as a science subject and placed it under the Faculty of Science in 1950. Secondly, a thorough revision of syllabus was undertaken and completed after long discussions in a series of staff meetings. The revised syllabus had five theoretical and three practical papers. Of the theoretical papers the first four were compulsory and the fifth elective. Out of the three hundred marks for the practical papers eighty was earmarked for "Special Practical work" which would be of the nature of either laboratory experiments, or case studies, or field surveys to be carried out for a year under supervision of a teacher of the Department.

The Silver Jubilee of the Indian Science Congress Association came off in 1938. The session was held in Calcutta. Many foreign scientists attended the session. C. G. Jung, Carl Spearman, C. S. Myers were amongst them. A committee headed by Myers recommended the opening of an Applied Psychology Section as a research and public utility service unit of the Department. The then Vice-Chancellor S. P. Mookerjee accepted the committee recommendation and the Applied Psychology Section was formally opened in September, 1938. M. N. Banerji, the seniormost lecturer of the Psychology Department was put in charge of it under the general supervision of G. Bose, the Head of the Department.

The Applied Section in the beginning adapted a number of foreign tests of intelligence, aptitude and personality for vocational and educational guidance. It established Indian norms of these tests by examining hundreds of school students of various age groups. In course of time, construction and

standardization of several Psychological tests were undertaken.

Till 1935 there had been no provision for post-graduate research scholarship in the Department of Psychology. In that year sanction for a Research Scholar was obtained and early in 1936 R. Ghosh, who passed out in 1935, was appointed Research Scholar. He went to London for Ph.D. degree on the following year. S. C. Sinha who came in his place, undertook to prepare a battery of group intelligence tests in Bengali. Subsequently, he was permanently absorbed in the teaching staff. In 1948, he went abroad, at first to America and then to Europe for advanced studies.

Facilities for outdoor and indoor hospital treatment for mental patients were but few in the pre-war days. G. Bose induced the authorities of the R. G. Kar Medical College at Belgachia to start a mental clinic for outdoor patients and himself attended the clinic in the morning twice a week. At about that time the well-known writer Rajshekhar Bose, an elder brother of G. Bose, made a free gift of a fairly large plot of land at Bediadanga with a small one-storied building on it for the purpose of founding a mental hospital. With the donations from several wealthy philanthropists the Lumbini Park Mental Hospital was founded in 1940. The students of Psychology could now have the opportunity to make first-hand observation of patients and attend clinical lectures given by the specialists.

In 1942, the War Department of the Government of India established an experimental Selection Board for recruitment of Indian youths to commissioned ranks. D. Ganguli was nominated to serve as the civi-

lian psychologist in the Selection Board temporarily. In 1943, full fledged Directorate of Personnel Selection was established with its headquarters at Meerut and five Selection Boards at five different parts of the country. A number of Indian Psychologists willing to serve in the War Department were interviewed by British army officials for appointment as Senior or Junior Psychologists for the period of duration of war. In 1944, S. K. Bose was the first Indian Psychologist selected for the post of Senior Psychologist at Meerut headquarters. After six months R. Ghosh was appointed the next Senior Psychologist. Several other appointments for the Senior and the Junior posts were made. Amongst them two were from Calcutta. Some of the incumbents were commissioned as Army Officers. In May 1945, R. Ghosh unfortunately died in a street accident.

D. Ganguli who had returned to Calcutta became the Research Fellow in the Applied Psychology Section in place of R. Ghosh. In 1945, one-year Certificate Course in Applied Psychology was started. Only graduates in Psychology or Education and holders of degrees in Medicine were admitted in that course. The Research Fellow and the Research Scholars of the Applied Psychology Section came to be regarded as members of the teaching staff while M. N. Banerji continued to be in charge of the Section.

N. N. Chatterji of the Applied Section made a number of important contributions to the study of abnormality. So did T. C. Sinha.

Before retirement G. Bose had initiated a move to open a post-graduate course in Applied Psychology as apart from the existing

course. S. C. Mitra took up the unfinished work of G. Bose, prepared the syllabus in consultation with his colleagues and got it accepted by the authorities. The new course was called B-Course. The first batch of students was admitted in that course in 1952. Since the inception of the B-Course, P. K. Bose, the Head of the Department of Statistics, Calcutta University kindly agreed

to teach Psychometry to the students and his valuable service was rendered for a long period of about two decades.

In brief this is the evolutionary history of the Department of Psychology.*

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Our Contributors

Section 1

Each of our great teachers, whose reflection have been cited, is an institution by himself. Their contributions as teachers, as researchers have crossed the threshold of contemporaneousness of time. Since we are all aware of their great achievements new introduction about them is possibly a futile repetition.

Section 2

An introductory note about each of the authors of this section except Dr. D. Banerjee has already been given at the beginning of this section.

Dr. D. Banerjee is an alumnus of Applied Chemistry Department. He got his M.Sc. degree in 1934 and Ph.D. from the University of London in 1938. At present he is the Managing Director of Escon Consultant (P) Ltd., Calcutta.

Section 3

Professor G. N. Bhattacharyya is retired Rashbehari Ghose Professor and Head, Department of Applied Physics. He retired in 1972. He joined the Department of Applied Physics in 1954 and served the Department as a teacher in various capacities. For his outstanding research work he was conferred with the D.Sc. degree of the University of Calcutta.

Professor R. N. Chakravarti is a distinguished alumnus of the University College of Science, Calcutta. He did his M.Sc. in 1939 coming first in the merit list. He later obtained D.Sc. degree of Calcutta University working with Late Professor J. C. Bardhan, a pioneering Synthetic Organic Chemist of International repute. Dr. Chakravarti was awarded 'Padmabhushan' in 1972. At present he is the Research Director of the R & D wing of Deys' Medical.

Professor (Mrs.) Asima Chatterjee, an outstanding alumnus of the Department of Chemistry, started her teaching career as a Honorary Lecturer in the Department in 1944. She was Khaira Professor from 1962-1982 and Dean of Faculty of Science (1969-1980). She was awarded the Bhatnagar award in 1961 and the 'Padmabhushan' in 1975. At present she is the Honorary Programme Coordinator of the

Centre of Advanced Studies on National Products in the Department of Chemistry.

Professor Parimalkanti Ghosh did his M.Sc. degree in Applied Mathematics and joined the Department as a Research Fellow in 1942 and later joined the faculty of the Department. He was the Rashbehari Ghose Professor of Applied Mathematics and also Head of the Department for about ten years till his retirement in 1983.

Professor S. N. Roy entered the Department of Psychology as a student in 1935. He joined the Department as a Research Scholar in 1938 and received the CU Jubilee Gold Research Prize in 1940. He started his teaching career in the Department of Experimental Psychology in 1943. He played a pivotal role for the formation of the Department of Applied Psychology. Professor Roy was the Founder and first Head of the Department during 1969-80, upto his retirement.

Professor A. K. Deb was one of the illustrious students of the Department of Physiology in the late twenties. He saw the beginning of this Department. He was a teacher of this Department for more than twenty years. Both as a Psychiatrist and as a teacher of Physiology he earned commendable reputation.

Professor Kanangopal Bagchi obtained his M.Sc. degree in Geology in 1940. He joined the Department of Geography as a teacher in 1941. His contributions to the development of the Department of Geography are invaluable. He was Professor and Head of the Department during 1981-83.

Professor S. K. Bose was Professor and Head of the Department of Psychology from 1962 to 1965, till his retirement. He was born in 1901 in Burdwan. He obtained the M.Sc. degree in Experimental Psychology in 1925 and M.A. in Philosophy in 1930 from the University of Calcutta. He was awarded Sir Asutosh Mookerjee Gold Medal twice in 1936 and in 1939. He joined the Department of Experimental Psychology as a teacher in 1928 and served for more than twentyeight years. For sometime he was Research Officer at UNESCO for Social & Economic Development in Southern Asia and later was Acting Director of that Centre.